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COAST GUARD RESEARCH AND DEVELOPMENT CENTER GROTON CONN
MARINE TRAFFIC DATA OF CORPUS CHRISTI, TEXAS. (U)
MAY 78 J J CHERNY, D E WATSON, R A SILVA

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CGR/DC-8/78

USCG-D-35-78

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REPORT NO. ³⁵ CG-D-78

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⑥ MARINE TRAFFIC DATA OF CORPUS CHRISTI, TEXAS.

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U. S. Coast Guard Research and Development Center
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⑬ USCG

⑭ D-35-78

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⑪ May 878

⑭ CGR/DC-8/78

⑨ Final Report

⑫ 85p.

Document is available to the U.S. public through
the National Technical Information Service
Springfield, Virginia 22161

PREPARED FOR
U.S. DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD
OFFICE OF RESEARCH AND DEVELOPMENT
WASHINGTON, D.C. 20500

78 07 31 053 408 730 JOB

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ADDENDUM

Because of error in printing, the following shall replace the listing of Figures 2-18 through 2-45 on Page iv.

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Technical Report CG-D-35-78
MARINE TRAFFIC DATA OF CORPUS CHRISTI, TEXAS

U.S. Coast Guard Research and Development Center
Avery Point, Groton, Connecticut 06340

ADDENDUM II

1. Cover Page - Pen change Report Number from CG-D-38-78 to CG-D-35-78
2. ADDENDUM Page - Pen change Channel 13 (Figure 2-21 only) to Channel 16

Technical Report Documentation Page

1. Report No. CG-D-35-78✓	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle MARINE TRAFFIC DATA OF CORPUS CHRISTI, TEXAS		5. Report Date May 1978	
		6. Performing Organization Code	
7. Author(s) J.J. Cherny III, D.E. Watson, R.A. Silva, and B.H. Charters		8. Performing Organization Report No. CGR&DC 8/78	
9. Performing Organization Name and Address United States Coast Guard Research and Development Center Avery Point Groton, Connecticut 06340		10. Work Unit No. (TRAIS)	
		11. Contract or Grant No.	
12. Sponsoring Agency Name and Address Department of Transportation United States Coast Guard Office of Research and Development Washington, DC 20590		13. Type of Report and Period Covered FINAL REPORT	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract <p>Data was recorded on the marine traffic and VHF-FM marine communications channel usage at Corpus Christi, Texas, during the period of 30 October to 5 November 1976. The marine traffic data was recorded by means of time-lapse photography of a radar display at Sun Oil Pipeline Dock, Ingleside, Texas. Recordings were made of the communications on VHF-FM maritime mobile Channels 13 and 16 as received at the site.</p> <p>The daily average of the marine traffic, including large, medium, small and tugs-in-tow, transiting the main ship channel and the Intracoastal Waterway at Corpus Christi was 68.</p> <p>Approximately 150 hours of communications on VHF-FM Channels 13 and 16 were recorded and monitored to determine the channel efficiency (i.e. the percentage of valid messages) and utilization. The Channel 13 efficiency at Corpus Christi was 41.23%, the utilization was 3.80%. The Channel 16 efficiency was 52.53%, the utilization was 5.06%.</p>			
17. Key Words Corpus Christi, main ship channel, Intracoastal Waterway, marine traffic, VHF-FM communications, VTS, Vessel Traffic Services		18. Distribution Statement Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161	
19. Security Classif. (of this report) UNCLASSIFIED	20. Security Classif. (of this page) UNCLASSIFIED	21. No. of Pages 83	22. Price

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures				Approximate Conversions from Metric Measures			
Symbol	When You Know	Multiply by	To Find	Symbol	When You Know	Multiply by	To Find
LENGTH				LENGTH			
in	inches	2.5	centimeters	mm	millimeters	0.04	inches
ft	feet	30	centimeters	cm	centimeters	0.4	inches
yd	yards	0.9	meters	m	meters	3.3	feet
mi	miles	1.6	kilometers	km	kilometers	1.1	yards
						0.6	miles
AREA				AREA			
sq in	square inches	6.5	square centimeters	cm ²	square centimeters	0.16	square inches
sq ft	square feet	0.09	square meters	m ²	square meters	1.2	square yards
sq yd	square yards	0.8	square meters	m ²	square kilometers	0.4	square miles
sq mi	square miles	2.6	square kilometers	km ²	hectares (10,000 m ²)	2.5	acres
	acres	0.4	hectares	ha			
MASS (weight)				MASS (weight)			
oz	ounces	28	grams	g	grams	0.035	ounces
lb	pounds	0.45	kilograms	kg	kilograms	2.2	pounds
	short tons (2000 lb)	0.9	tonnes	t	tonnes (1000 kg)	1.1	short tons
VOLUME				VOLUME			
tsq in	teaspoons	5	milliliters	ml	milliliters	0.03	fluid ounces
fl oz	fluid ounces	16	milliliters	ml	liters	2.1	pints
c	cups	0.24	liters	l	liters	1.06	quarts
pt	pints	0.47	liters	l	cubic meters	0.26	gallons
qt	quarts	0.96	liters	m ³	cubic meters	35	cubic feet
gal	gallons	3.8	liters	m ³	cubic meters	1.3	cubic yards
cu ft	cubic feet	0.03	cubic meters				
cu yd	cubic yards	0.76	cubic meters				
TEMPERATURE (exact)				TEMPERATURE (exact)			
F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weight and Measure, Price \$2.25, SD Catalog No. C13.10-286.



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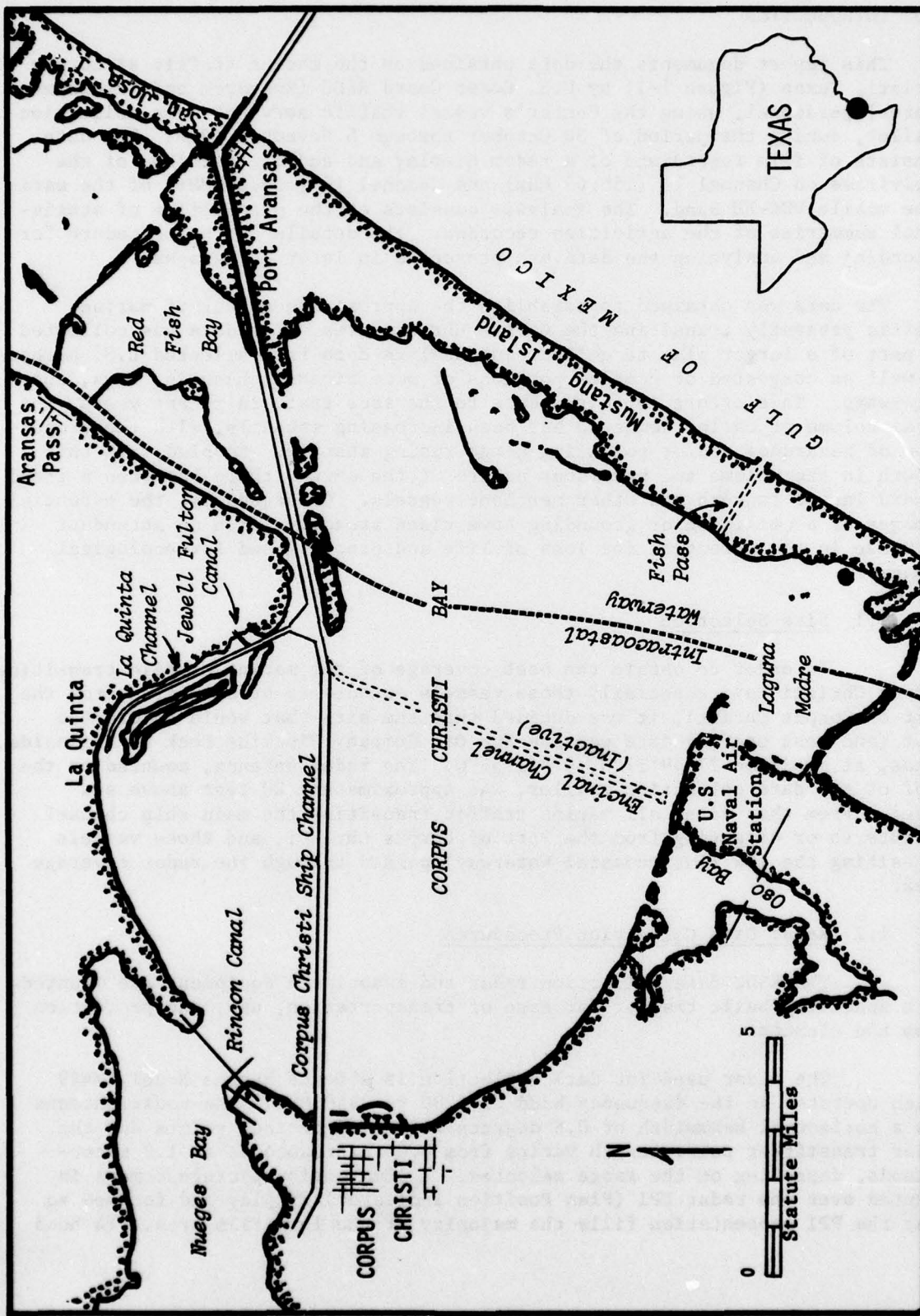


FIGURE 1-1: CORPUS CHRISTI BAY

1.0 INTRODUCTION

This report documents the data obtained on the marine traffic at Corpus Christi, Texas (Figure 1-1) by U.S. Coast Guard R&DC (Research and Development Center) personnel, using the Center's vessel traffic services data collection trailer, during the period of 30 October through 5 November 1976. The data consists of film recordings of a radar display and audio recordings of the activities on Channel 13 (156.65 MHz) and Channel 16 (156.80 MHz) of the maritime mobile VHF-FM band. The analysis consists of the preparation of statistical summaries of the activities recorded. The details of the procedure for recording and analyzing the data are presented in later paragraphs.

The data was obtained to establish the approximate amount of marine traffic presently transiting the Corpus Christi area. The data was collected as part of a larger plan to collect and analyze data from selected U.S. harbors as well as congested or complex portions of some rivers, channels, bays, and waterways. This effort is in response to the fact that, in recent years, the total volume of marine commerce has been increasing steadily, with the proportion of hazardous and/or polluting cargo rising sharply. Coupled with this growth in the volume and hazardous nature of the cargo, there has been a trend toward larger tankers and other merchant vessels. Consequently, the potential damages of a collision or grounding have risen steadily, with an attendant increase in the potential for loss of life and property and for ecological damage.

1.1 Site Selection

In order to obtain the best coverage of the marine traffic transiting Corpus Christi Bay, especially those vessels enroute to or departing from the Port of Corpus Christi, it was decided that the site that would afford the most (and most useful) data was the Sun Oil Company Pipeline Dock at Ingleside, Texas, at position 27°49'17"N, 97°11'55"W. The radar antenna, mounted on the roof of the data collection trailer, was approximately 20 feet above sea level. From this site, all marine traffic transiting the main ship channel enroute to or departing from the Port of Corpus Christi, and those vessels transiting the ICW (Intracoastal Waterway) passed through the radar coverage area.

1.2 Radar Data Collection Procedures

The R&DC data collection radar and associated equipment are mounted in a specially built trailer for ease of transportation, use, and protection from the elements.

The radar used for data collection is a Decca Marine Model RM429 which operates in the frequency band of 9380 to 9440 MHz. The radar antenna has a horizontal beamwidth of 0.8 degrees at the -3 decibel points and the radar transmitter pulse length varies from 0.05 microseconds to 1.2 microseconds, depending on the range selected. A 16mm motion picture camera is mounted over the radar PPI (Plan Position Indicator) display and focused so that the PPI presentation fills the majority of the 16mm film area. (A hood

is used to screen out ambient light.) The camera is operated in the single-frame, time-lapse mode with the shutter of the camera controlled by a solenoid. The solenoid is activated by the radar heading flasher switch so that the shutter is held open for one complete revolution of the radar antenna, then closed for the second revolution, open for the third revolution, and so on. As a result of this procedure, the film consists of "snapshots" of the entire sweep of the radar, which is pleasing to the eye and easier to interpret than a conventional motion picture.

Mounted above and below the PPI display, and within the field of view of the camera, are small, alpha-numeric display panels. Auxiliary circuitry is used to display, on these panels, the date and time and geographic name of the radar site. As a result, each frame of the 16mm film contains the time it was exposed and the location of the radar at that time. This information simplifies the task of determining vessel speeds or the time an observed event occurred.

The radar has the capability of orienting the PPI display in any direction. The display is set up with true north at the top of the 16mm film frame when viewed so that the alpha-numeric characters are properly oriented. However, due to various limitations, the orientation of the film image with respect to true north is only accurate to ± 5 degrees.

The radar has also the capability of offsetting the antenna location from the center of the PPI display. This capability allows the PPI display to be oriented so that a particular area of interest fills a greater portion of the 16mm film frame than would otherwise be possible.

Although the radar is equipped with the usual heading flasher, fixed and variable range rings, and bearing cursor, they are usually suppressed and do not appear on the film imagery.

After the radar data collection trailer is located at a given site, tested, and adjusted, data is usually recorded on a 24-hour-a-day basis for seven days with a frame of film being exposed approximately every five seconds during this period. However, a few minutes of data are lost every five hours when the film is changed.

1.3 Communications Collection Procedures and Equipment

The data collection trailer is equipped, in addition to the radar system mentioned previously, with VHF-FM receivers tuned to Channels 13 and 16 of the maritime mobile band. The audio output of these receivers and a time code are recorded on magnetic tape cassettes. In addition, the audio signal is sent to an automated channel utilization recording system, to be described in a later paragraph. The purpose of these recording systems is to document the present utilization and efficiency of these channels, both of which are important to the safe and orderly movement of marine traffic. Channel 16 is used to alert others to a distress or emergency situation, or to establish initial communications with another station (ship). Channel 13 is used in inland waters by the bridge personnel of vessels in meeting, crossing, or overtaking situations, to agree on the action they are each to take to avoid collision.

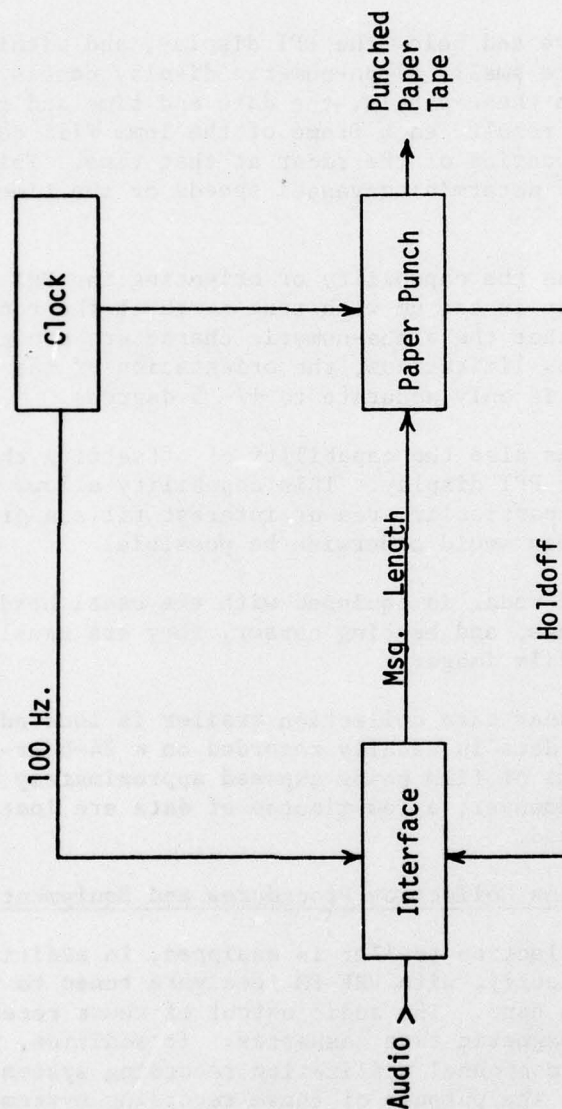


FIGURE 1-2: COMMUNICATIONS DATA COLLECTION

C U/W-FOCAL: VTS 09/14/77

```
01.01 C INITIALIZE THE PROGRAM
01.02 C THIS IS VERY SIMILAR TO THE 'FOCAL-69' ROUTINE
01.05 O 0;0 I;ASK "ENTER A ONE (1) IF YOU ARE AT A NEW SIGHT ",X,!!
01.07 I (X-1)1.10,,1.10;T "ENTER SIGHT NAME (MAX 40 CHARACTERS) END"
01.08 T " HEADER WITH A 'RETURN'!!!;F I=1,40;S SI(I)=FIN();I (SI(I)-141),1.09,
01.09 B;S SI(0)=I-1
01.10 T "ENTER DATE OF RUN AS 'DD-MMM-YY' AND TERMINATE WITH A RETURN":
01.15 FOR I=1,40;S DA(I)=FIN();I (DA(I)-141),1.20,
01.20 B;S DA(0)=I-1;Z TIME,SH,PG,NT,TOTIME;F Z=1,21;Z A(Z)
01.22 A "ENTER THE CHANNEL TO BE DONE = ",CH,!!
01.24 T "THE HEADER IS: "!!
01.25 X FOUT(140);T !!;F I=1,,SI(0); X FOUT(SI(I))
01.26 T :35"VHF-FM CH",%2.00,CH
01.27 T :55;F I=1,DA(0);X FOUT(DA(I))
01.28 Y PG;T :70"PAGE"%1.00,PG,!!
01.30 A "ENTER A ZERO OR A RETURN IF ALL IS 'OK' ",X,!!;I (X),1.35,,G
01.35 S TM=15;Z PG
01.40 T "LOAD THE FIRST TAPE INTO THE READER. TYPE ANY CHARACTER WHEN READY":
01.45 O 0 LPT;;0 I HSR
01.50 D 1.25,1.26,1.27,1.28;T !"TRANSMISSION TIME HISTOGRAM",!!
01.60 T "PERIOD ENDING: NUMBER OF XMSNS: MINUTES: "
01.61 T " PERCENT:",!!

02.10 A X;I (FTRM()-154),2.15,,;I (3999-X)4.05,4.05,3.05
02.15 O 0;0 I;A "MORE DATA TO ENTER (1=YES) ",X,
02.20 I (X-1)2.25,,2.25;T !LOAD THE TAPE INTO THE READER";D 2.30;G 2.10
02.25 O R 0;S X=6401;G 4.05
02.30 O R 0;0 I HSR:

03.04 C HANDLE DATA
03.05 I (X-1000)3.06;S X-X-1000
03.06 I X-1),,3.10;Y SHORTONES;G 2.10
03.10 S TIME=TIME+(X/10),TOTIME=TOTIME+(X/10),X=FMIN((FTR(X*.199)+1,21)
03.20 Y A(X),NT,NR;G 2.10

04.04 C HANDLE TIME INFORMATION
04.05 I (X-4000-TM)2.10
04.15 T " ",%6.00,TM," ",NT," ",%4.02,TIME/60
04.20 T " ",%6.02,TIME/9,!!
04.25 I ((TM/100)-FTR(TM/100)-.40)4.30; S TM=TM+40
04.30 S TM=TM+15;Z TI,NT;I (TM-1215),4.45,,;I (TM-2400)4.05,,;I (X-6400)4.05,,;G 5.05
04.45 D 1.50,1.60,1.61;I (TM-2400)4.05,,;I (X-6400)4.05,,

05.04 C DATA SUMMARY
05.05 D 1.25,1.26,1.27,1.28
05.10 T !! "TOTAL NUMBER OF TRANSMISSIONS" ",%5.00,NR,!!
05.15 T "AVE. NUM. OF TRANSMISSIONS PER HOUR: ",%4.01,NR/24,!!
05.20 T "TOTAL TRANSMISSION TIME:
05.21 T %5.03,TOTIME/3600," HOURS",!
05.25 T "AVERAGE LENGTH OF TRANSMISSION: ",%5.02,TO/NR," SEC.",!
05.30 T "PERCENT CHANNEL UTILIZATION: ",TO/864,"%",!!!!
05.35 T "MESSAGE LENGTH HISTOGRAM",!!
05.40 T "LENGTH OF XMSNS NUMBER OF XMSNS PERCENT",!
05.45 S #=.4,F Z=1,1,20; D 6
05.50 T "LONGER THAN 10 SEC.: ",%4.00,A(21)," "
05.55 T %6.02,(A(21)/NR)*100,!!!!!!!!!!!!!!
05.58 T "THERE WERE",%5.00,SH," XMSNS OF 00.1 AND 00.0 DURATION":
05.60 O 0;0 I;G

06.10 S TD=Z*.5; S PN=(A(Z)/NR)*100
06.15 T %3.01,TD-#, " -",TD," SEC. ",%6.00,A(Z)," "
06.16 T %6.02,PN,!!;S #=.5
```

FIGURE 1-3: COMPUTER PROGRAM TO ANALYZE RADIO COMMUNICATIONS DATA

DEFINITION OF VARIABLES FOR "VTS"

A(Z)	Length of transmission count for Message Length Histogram
DA(I)	Date of run, in special characters [DA(0)= number of characters in array]
CH	Channel being analyzed. Normally either 13 or 16
I	Loop counter used throughout program
NR	Total number of transmissions longer than 1 second
NT	Total number of transmissions in the 15 minute interval being analyzed. (Not including any of 00.1 duration)
PG	Page number
PN	Temporary variable used to establish percent of transmissions with specific message length
SI(I)	Sight Identification in special characters [SI(0)= number of characters in array]
SHORTONES	Transmissions having a coded duration of either 00.0 or 00.1. These DO NOT appear in 'NR'
TD	Temporary variable used to establish length of transmissions for Message Length Histograms
TIME	Total time of transmissions found in 15 minute interval being analyzed (Not including any of 00.1 duration)
TM	Upper limit of 15 minute interval being analyzed
TOTIME	Total time of all transmissions (Not including any of 00.1 duration)
X	Number read from data tape, dummy variable in "HANDLE DATA", and dummy variable throughout "INITIALIZE"

FIGURE 1-3 (continued)

The contents of the tape cassettes are manually monitored and a statistical summary of the appropriateness of the communications is compiled. In addition, histograms of message activity versus time of day and other statistics are compiled during representative periods by means of an automated channel utilization recording system. In this system, an interface circuit accepts an audio input from the receivers and timing data from a digital clock. The output of the interface circuit causes a punch to record on paper tape the time (received from the digital clock) and the message length of each transmission. A block diagram of the system appears in Figure 1-2. The paper tape is then processed in a mini-computer to generate histograms of the number of transmissions versus time of day and message length. The computer program appears in Figure 1-3.

The receiver squelch settings are adjusted so that they open due to noise bursts relatively infrequently.

Personnel monitor the receivers frequently during the data punching process to ensure the system was operating properly and that the data was reasonable.

The tape recorder amplifier gain is reset as required to provide a proper signal to the remainder of the system. The speed of the tape recorders is checked by monitoring the IRIG-format time code recorded on the Channel 16 track of the tape recorder.

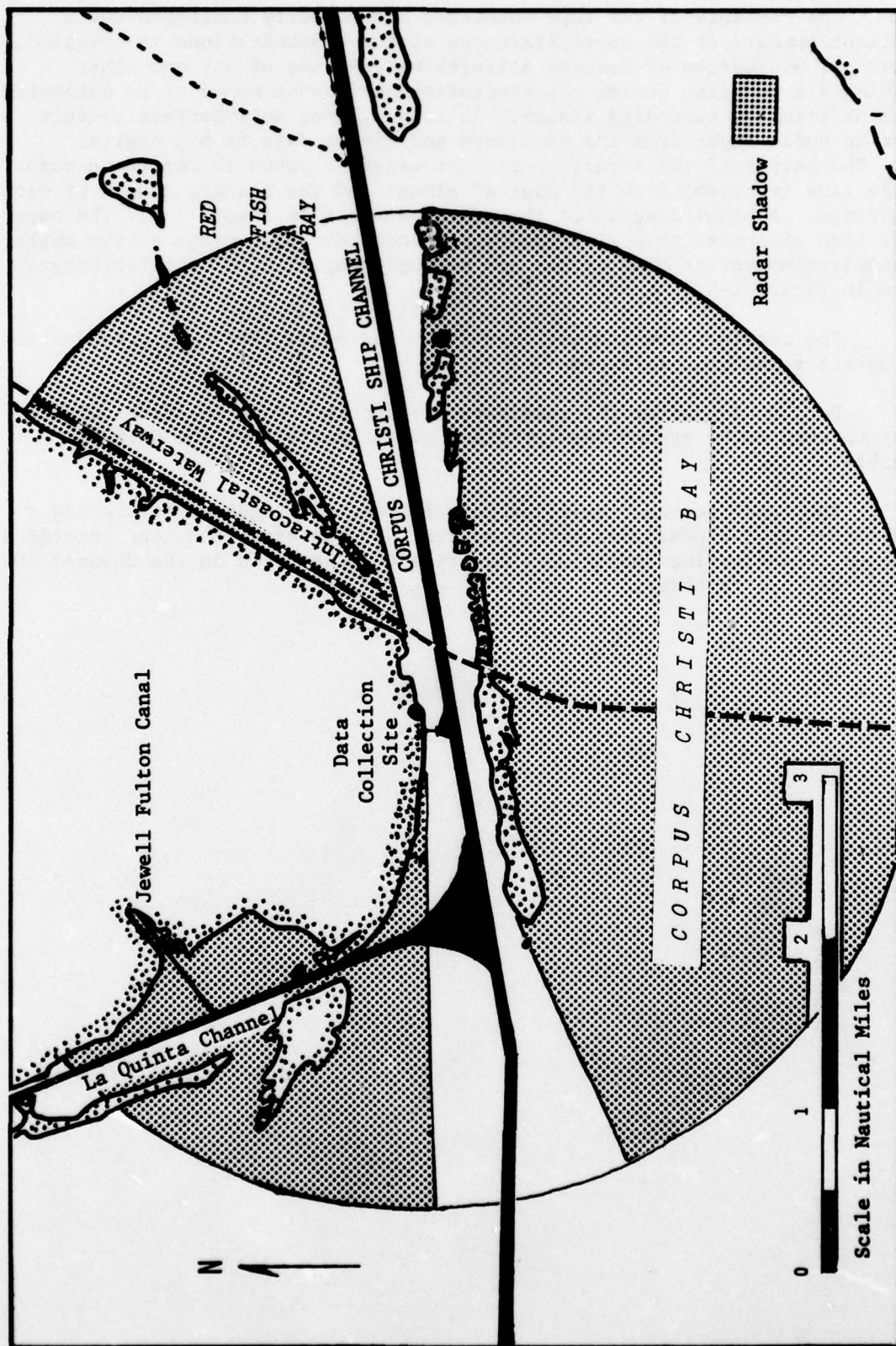


FIGURE 2-1: AREA OF RADAR COVERAGE

2.0 DISCUSSION OF DATA

The information contained in this chapter was collected at the Sun Oil Company Pipeline Dock, Ingleside, Texas, during the period of 30 October to 5 November 1976. The radar was operated on the three nautical mile scale during the data collection period. Figure 2-1 indicates the area of radar coverage.

2.1 Vessel Density

In general, the following information can be extracted from the time-lapse radar film:

1. Vessel density
2. Vessel speed
3. Destination
4. Anchorage locations
5. Closest point of approach (CPA) to other vessels
6. Number and time of occurrence of meeting situations
7. Number and time of occurrence of overtaking situations
8. Number and time of occurrence of crossing situations

The vessel density within the radar coverage area is presented in Figures 2-2 through 2-8. Vessel density is defined as the count of all vessels present within the radar coverage area taken at 15-minute intervals. The interval between counts was chosen to be equal to or less than the average vessel transit time through the radar coverage area. The vessels counted were classified by type and size, such as large (larger than 300 feet), medium, small (less than 100 feet), tug-in-tow, etc., determination of size being evaluated from the size relationship of the radar image. The "small" category includes fishing vessels, pleasure craft, and tugs that were not recognized as such. The data is presented as a histogram with time of day as the abscissa.

The maximum number of simultaneous movements observed at Corpus Christi was 7, occurring at 1100 on Tuesday, 2 November 1976 and at 0730 on Wednesday, 3 November 1976. This number represents the presence of 7 small vessels on Tuesday and 1 large and 6 small vessels on Wednesday.

The average of daily vessel transits among the channels is presented in Figure 2-9. To better present the traffic volume by area, the main ship channel and the ICW are each designated by letter, Section A being that part of the main ship channel east of the ICW; Section B is the main ship channel west of the ICW; Section C is that portion of the ICW south of the main ship channel; Section D is that portion of the ICW north of the main ship channel. The daily average per section is as follows:

<u>VESSEL SIZE</u>	<u>SECTION A</u>	<u>SECTION B</u>	<u>SECTION C</u>	<u>SECTION D</u>
Large	8	8	0	0
Medium	5	8	1	5
Small	34	32	26	33
Tug-in-tow	1	0	0	0

There were four close encounters observed during the data collection period. An encounter between two medium or large vessels was deemed a "close encounter" if the distance between the vessels at their closest point of approach was less than 300 yards.

There were no overtaking or crossing situations between medium or large vessels during the radar data collection period.

2.2 Vessel Speeds

The vessel speed data is based on the speeds of virtually all of the vessels imaged by the radar and is presented in Figures 2-10 through 2-16. A summary follows:

30 Oct - Saturday	2.0 - 27.0 knots (10.09 knots average)
31 Oct - Sunday	1.0 - 23.0 knots (9.91 knots average)
1 Nov - Monday	2.0 - 22.0 knots (7.97 knots average)
2 Nov - Tuesday	4.0 - 23.0 knots (7.98 knots average)
3 Nov - Wednesday	2.0 - 23.0 knots (8.43 knots average)
4 Nov - Thursday	2.0 - 31.0 knots (9.78 knots average)
5 Nov - Friday	2.0 - 23.0 knots (9.33 knots average)

Vessel speeds are determined by noting the distance in hundreds of yards that the vessel travels in three minutes, then applying the three-minute rule for speed, which states that the hundreds of yards a vessel travels in three minutes is its speed. Example, if a vessel travels 2,350 yards in three minutes, its speed is 23.5 knots.

All vessel speed data is dependent upon two factors: time and distance. The time component is held constant at three minutes and is measured by reading directly from the radar film. Since the individual frames are separated by at most five seconds, the error limit for each time measurement is, at most, +/- 1.4 percent. Also, in measuring the distance between two points, there is always the error associated with the smallest division of the ruler used. Additionally, the radar returns were not always distinct and symmetrical, thus measurement to the center of the return involves some estimation.

2.3 Route Identification

A route identification of the marine traffic transiting the Corpus Christi Channel and ICW between 0000 and 0930 on Monday, 1 November 1976, is presented in Figure 2-17. The tracks represent the transits of 4 large, 1 medium, and 14 small vessels.

2.4 Communications Data Analysis

Approximately 150 hours of communications traffic from VHF-FM Channels 13 and 16 were recorded during the period of 30 October to 5 November 1976. The receiving antennas were located at the forward part of the data collection trailer.

As mentioned previously, the recordings are monitored manually to prepare the histograms of message activity and channel efficiency for representative intervals during the period.

With respect to the Communications Message Activity histograms (Figures 2-18 through 2-31), a "valid" message is one that is appropriate for the channel that was used, such as the exchange of navigational or maneuvering information on Channel 13, and calls to initially establish communications on Channel 16. The "other" messages are those with squelch or indistinguishable transmissions, including those not spoken in the English language.

The Communications Channel Efficiency histograms (Figures 2-32 through 2-45) indicate the percentage of messages transmitted that were appropriate for the particular channel that was used.

Regarding the computer-prepared histograms (Figures 2-46 through 2-49):

- Note that the figures in the column headed "PERIOD ENDING" are time intervals printed without the customary leading zeros. Thus, the time "0015" is shown as "15." The "MINUTES" column contains the total time occupied by transmissions during the period, while the "PERCENT" column indicates the percentage of the given period during which the channel was in use.
- It is probable that a number of the messages of less than 0.5 second in length are simply noise bursts. However, since it is common practice to acknowledge a transmission by briefly keying the transmitter (with no voice modulation), it did not seem desirable to ignore any usable signal. Thus, the figures for messages of less than 0.5 second should be used with caution.

The "number of messages" counts occasionally differ between the manually-reduced data and the machine-reduced data. This difference is apparently due to the machine detecting breaks in the signals being transmitted that were either not detected or were ignored by the personnel performing the manual analysis. The figures for duration of channel utilization obtained manually agreed well with those obtained by the automated equipment, indicating that the automated equipment is operating properly.

The channel efficiency (i.e., the percentage of valid messages) at Corpus Christi is as follows:

<u>CHANNEL 13</u>	<u>CHANNEL 16</u>
41.23%	52.53%

The channel utilization exhibited the following peak and average values:

<u>CHANNEL 13</u>		<u>CHANNEL 16</u>	
<u>PEAK</u>	<u>AVERAGE</u>	<u>PEAK</u>	<u>AVERAGE</u>
41%	3.80%	33%	5.06%

2.5 Weather Data

Weather data, including the cloud coverage, wind direction and velocity, and visibility in nautical miles, is collected every hour, on the hour.

The following visibilities were recorded:

>6 nautical miles = 63%
4-6 nautical miles = 23%
1-3 nautical miles = 11%
<1 nautical mile = 3%

The longest period in which visibilities were less than one nautical mile was between 0100 and 0700 on Friday, 5 November 1976.

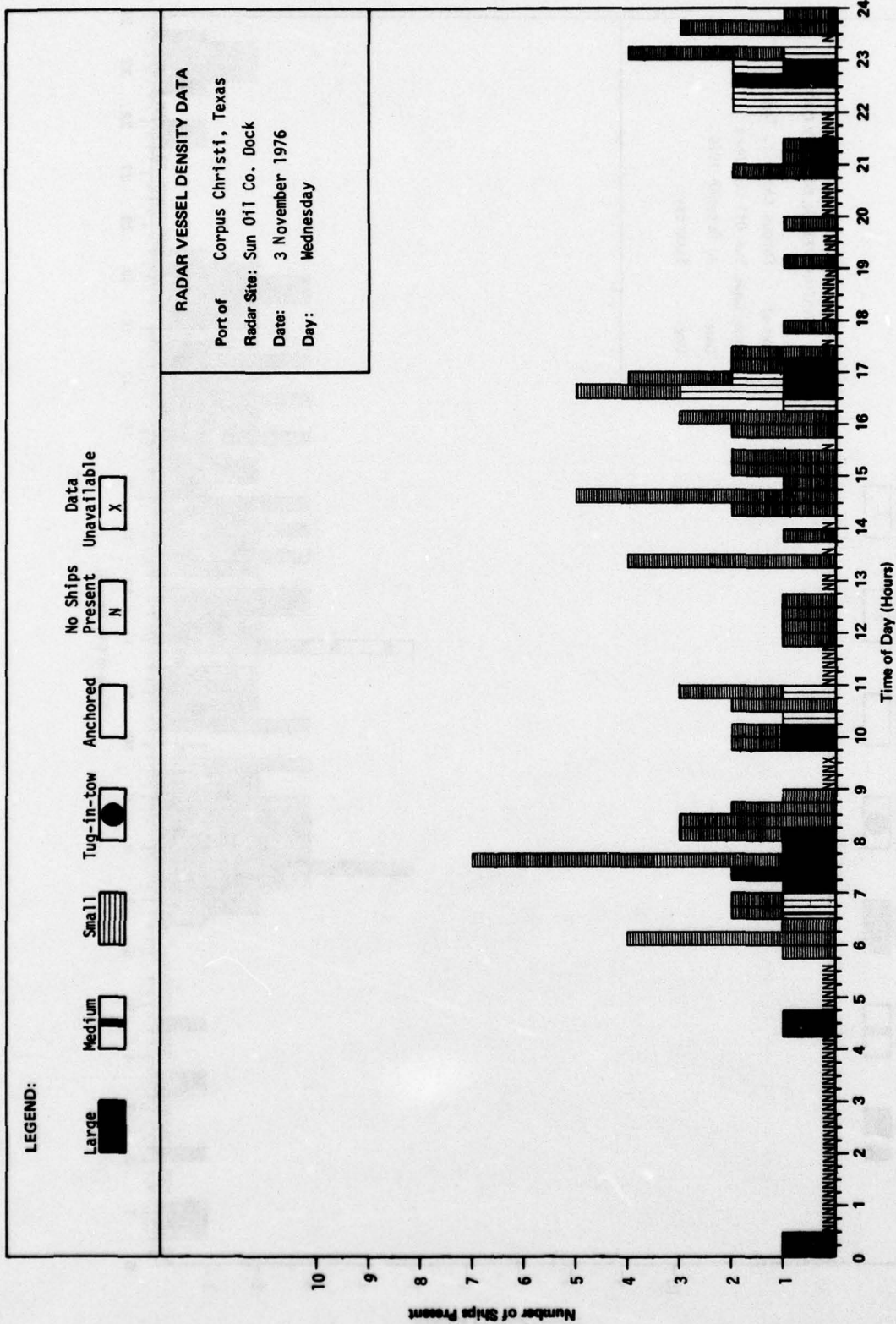


FIGURE 2-2

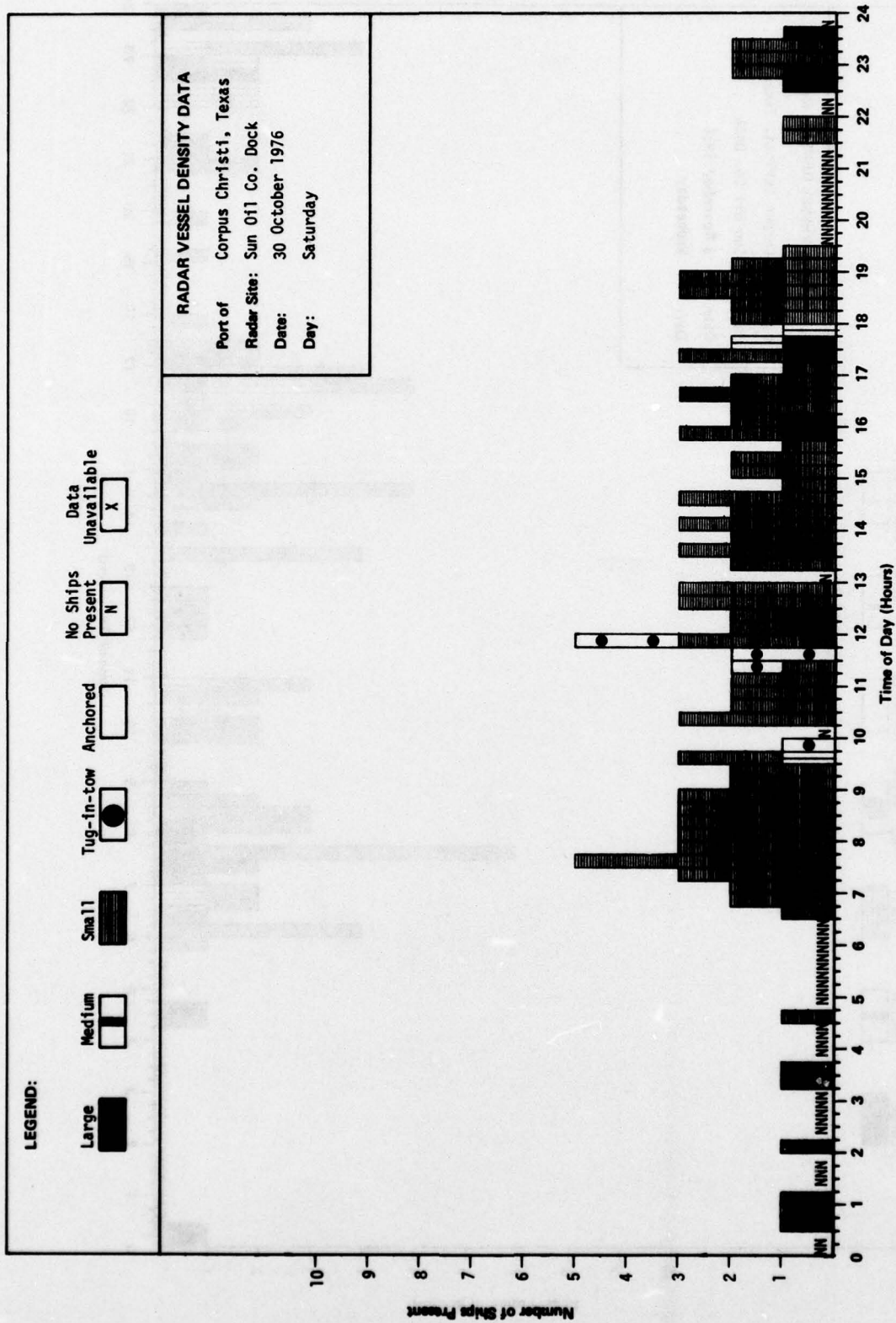


FIGURE 2-3

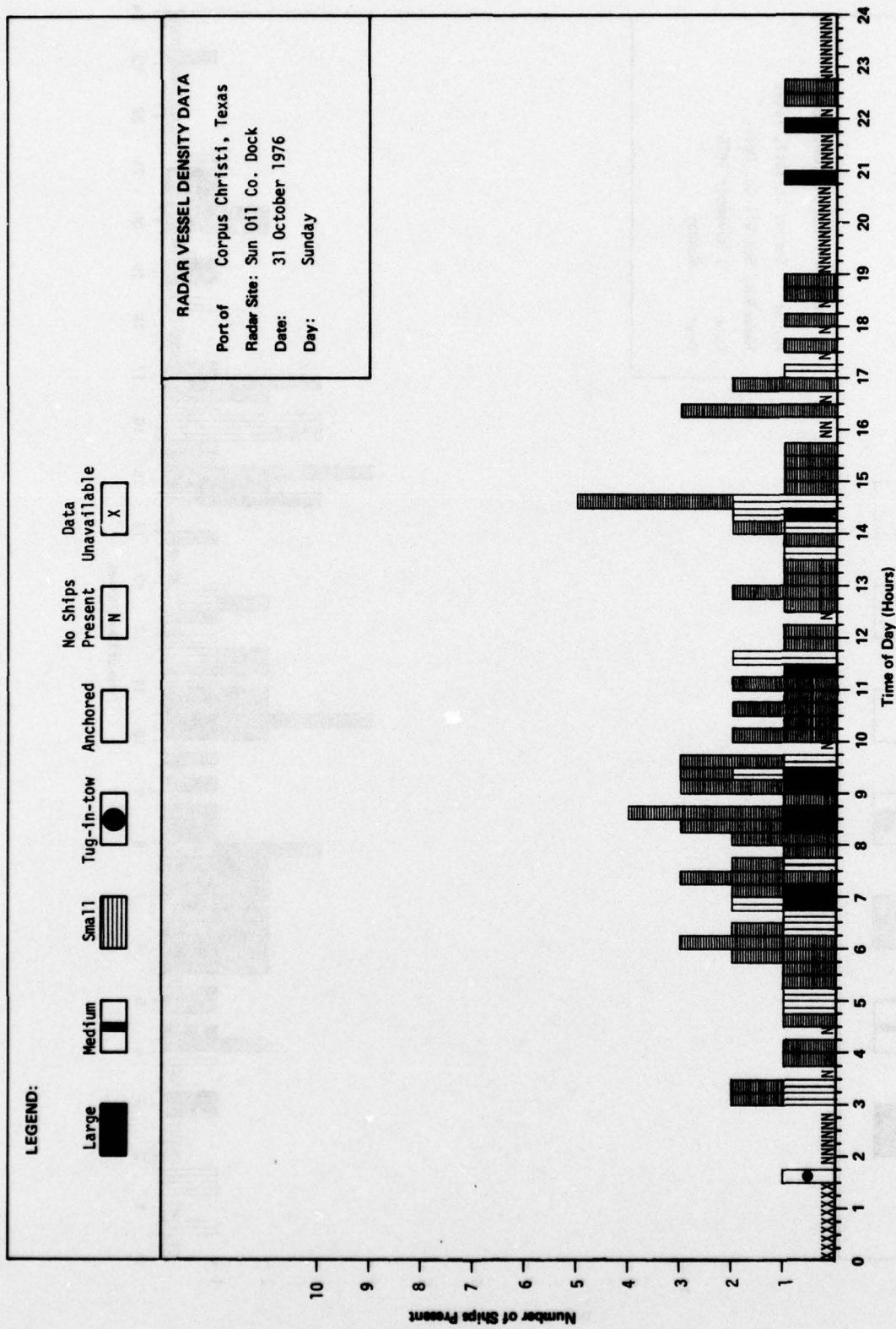


FIGURE 2-4

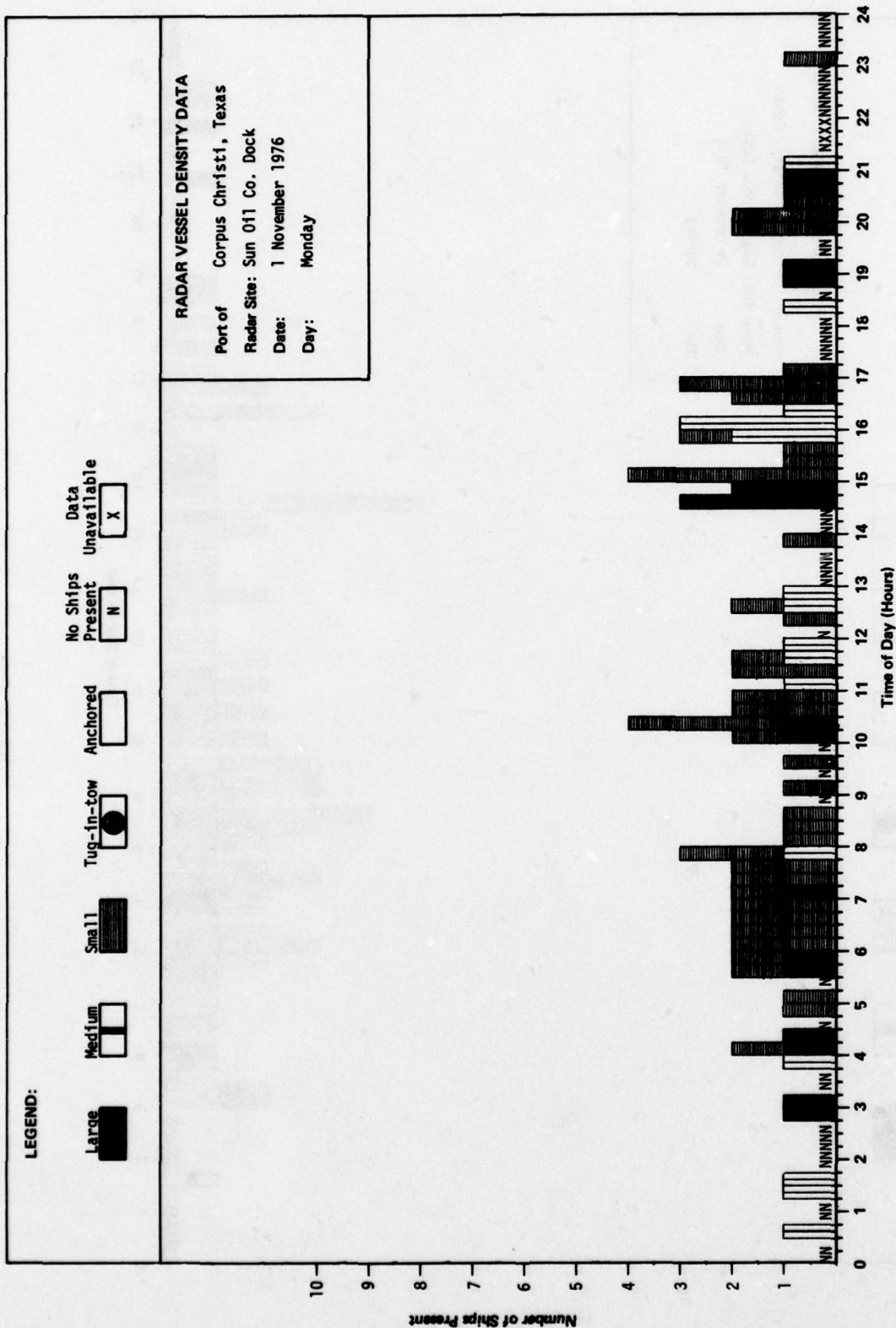


FIGURE 2-5

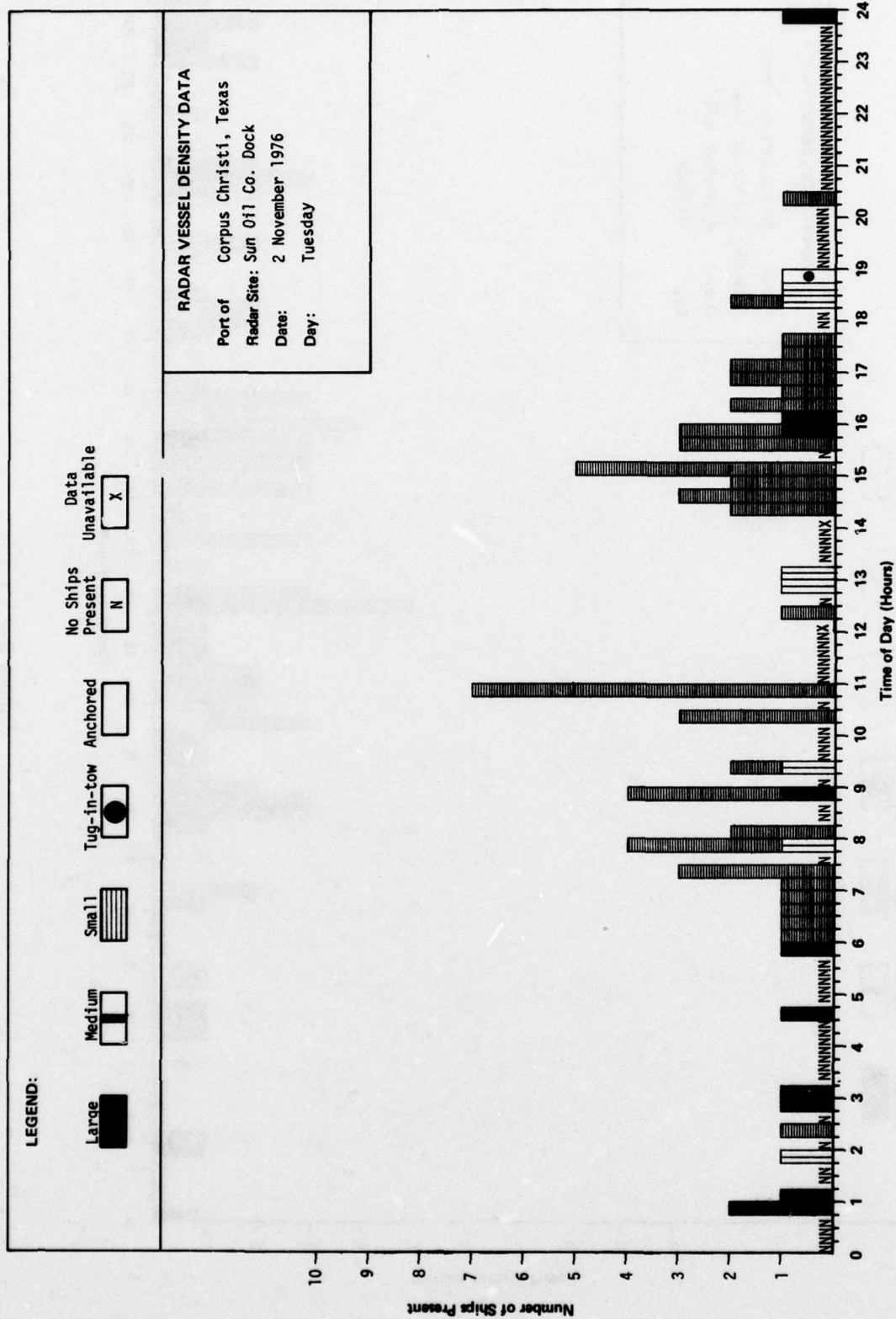


FIGURE 2-6

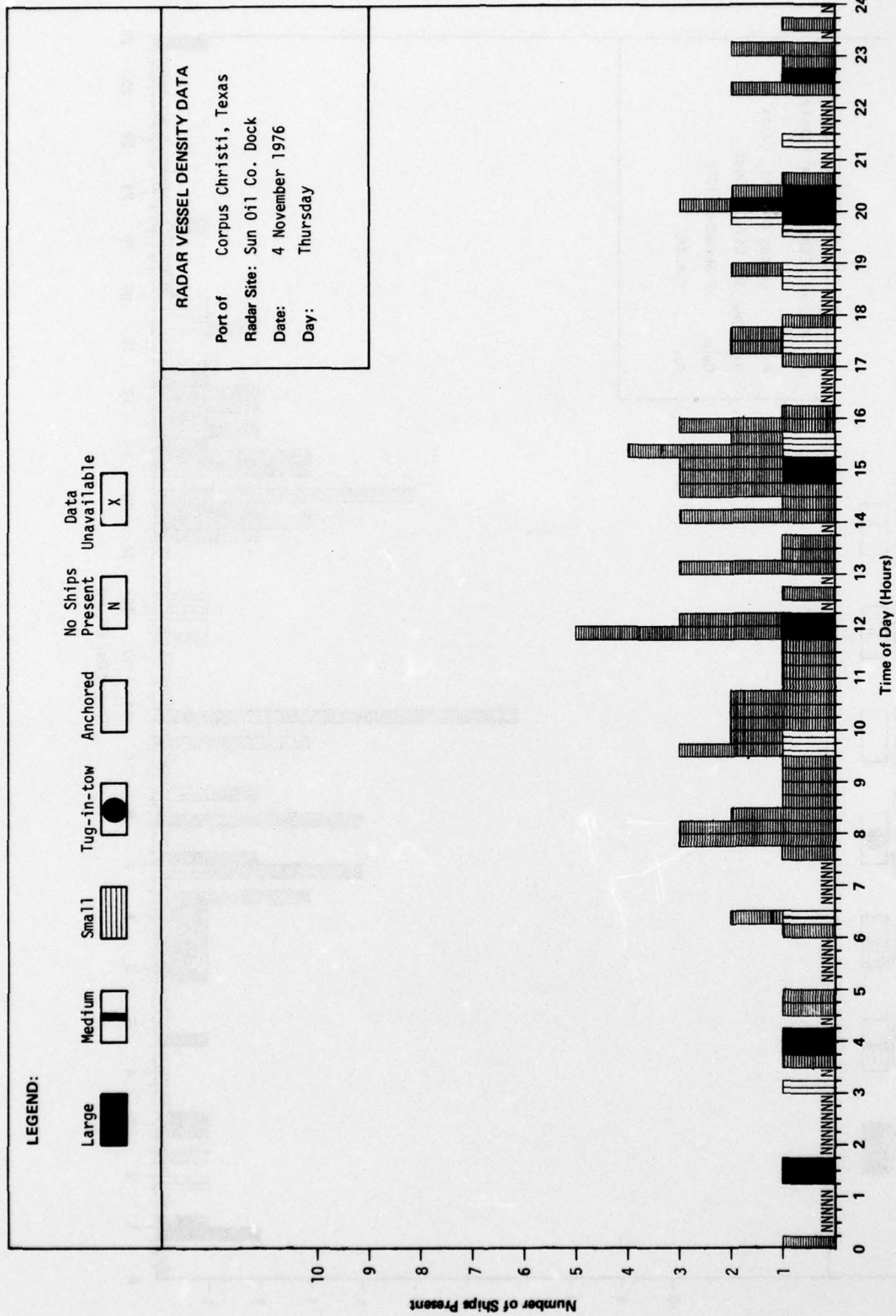


FIGURE 2-7

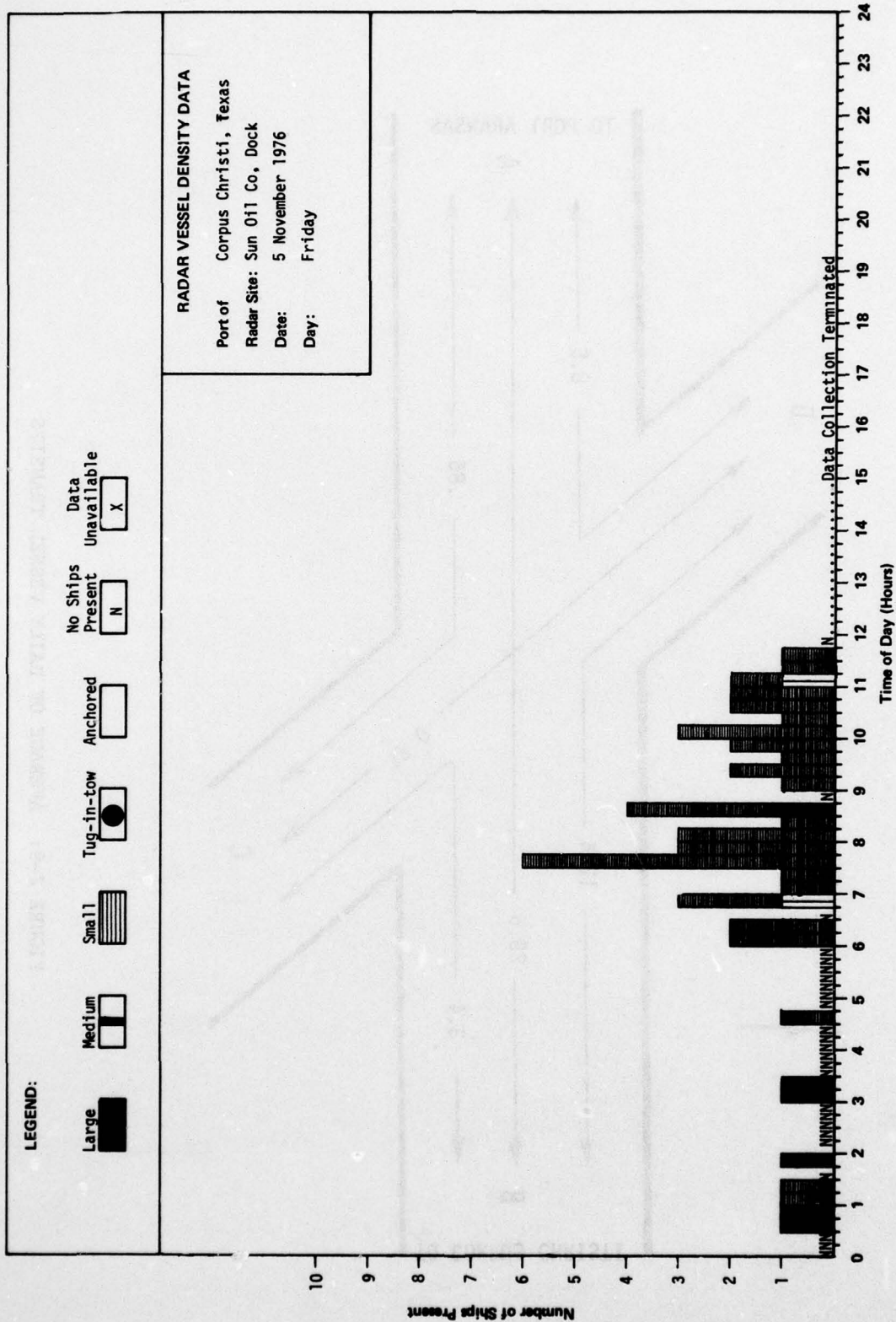


FIGURE 2-8

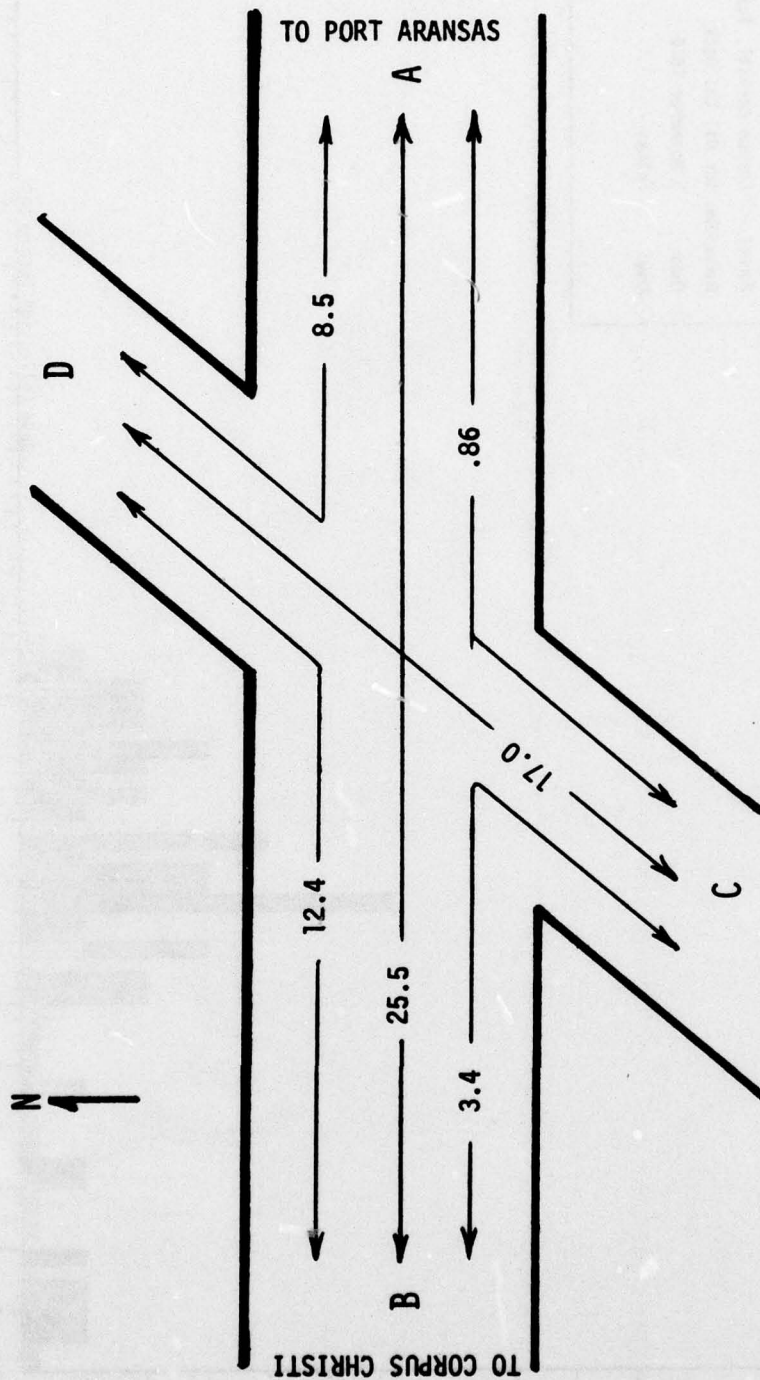


FIGURE 2-9: AVERAGE OF DAILY VESSEL TRANSITS

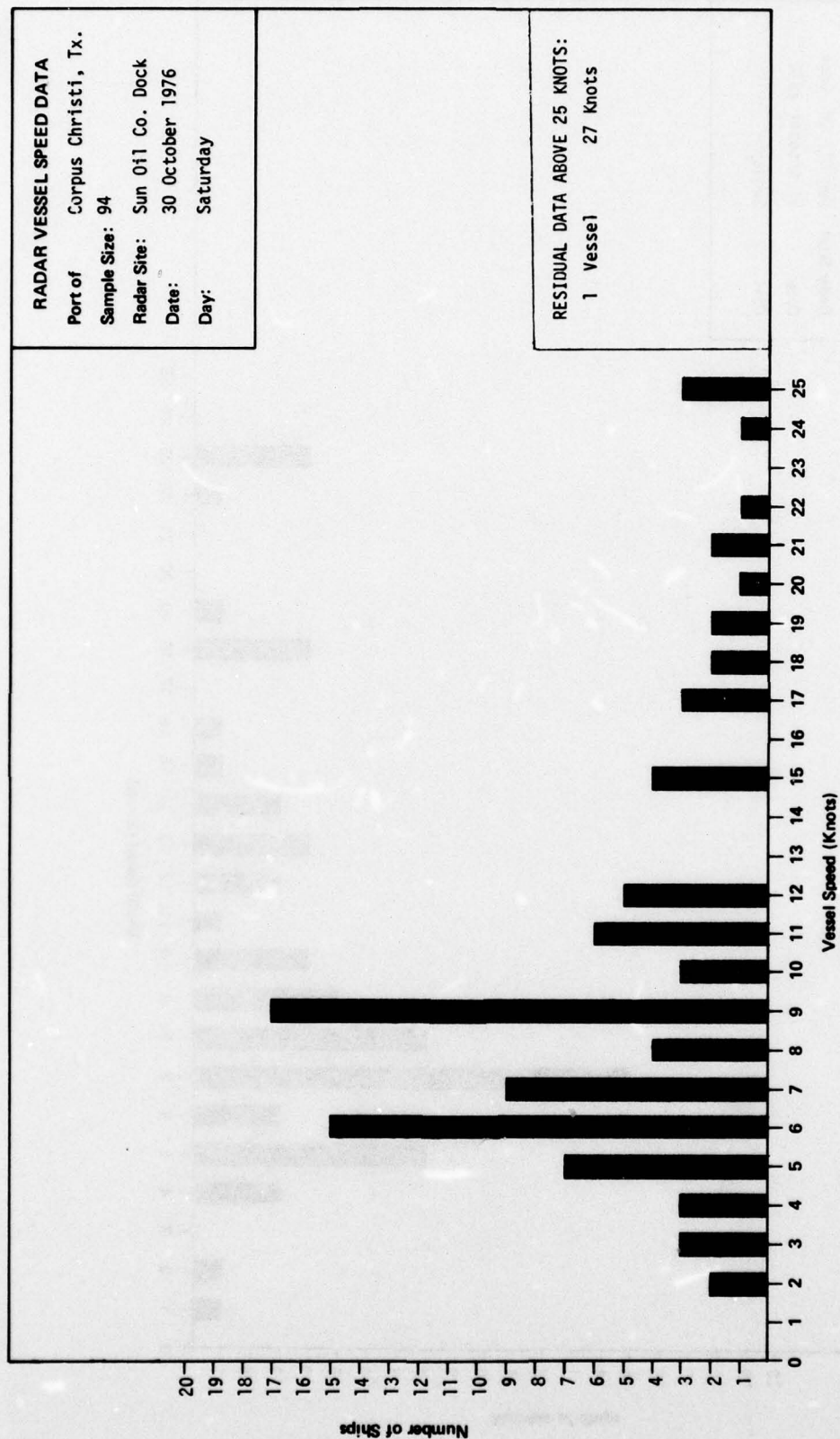


FIGURE 2-10

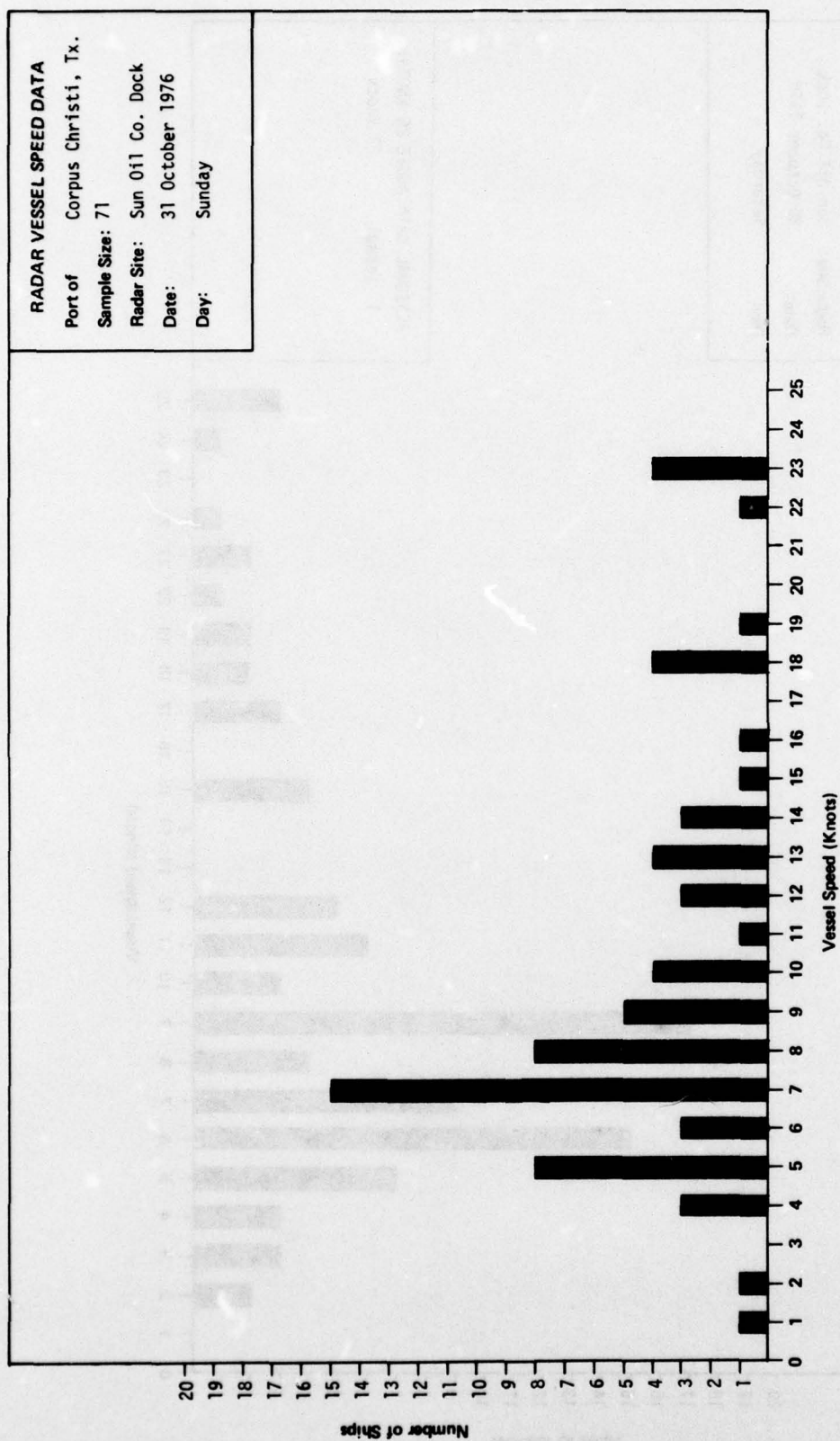


FIGURE 2-11

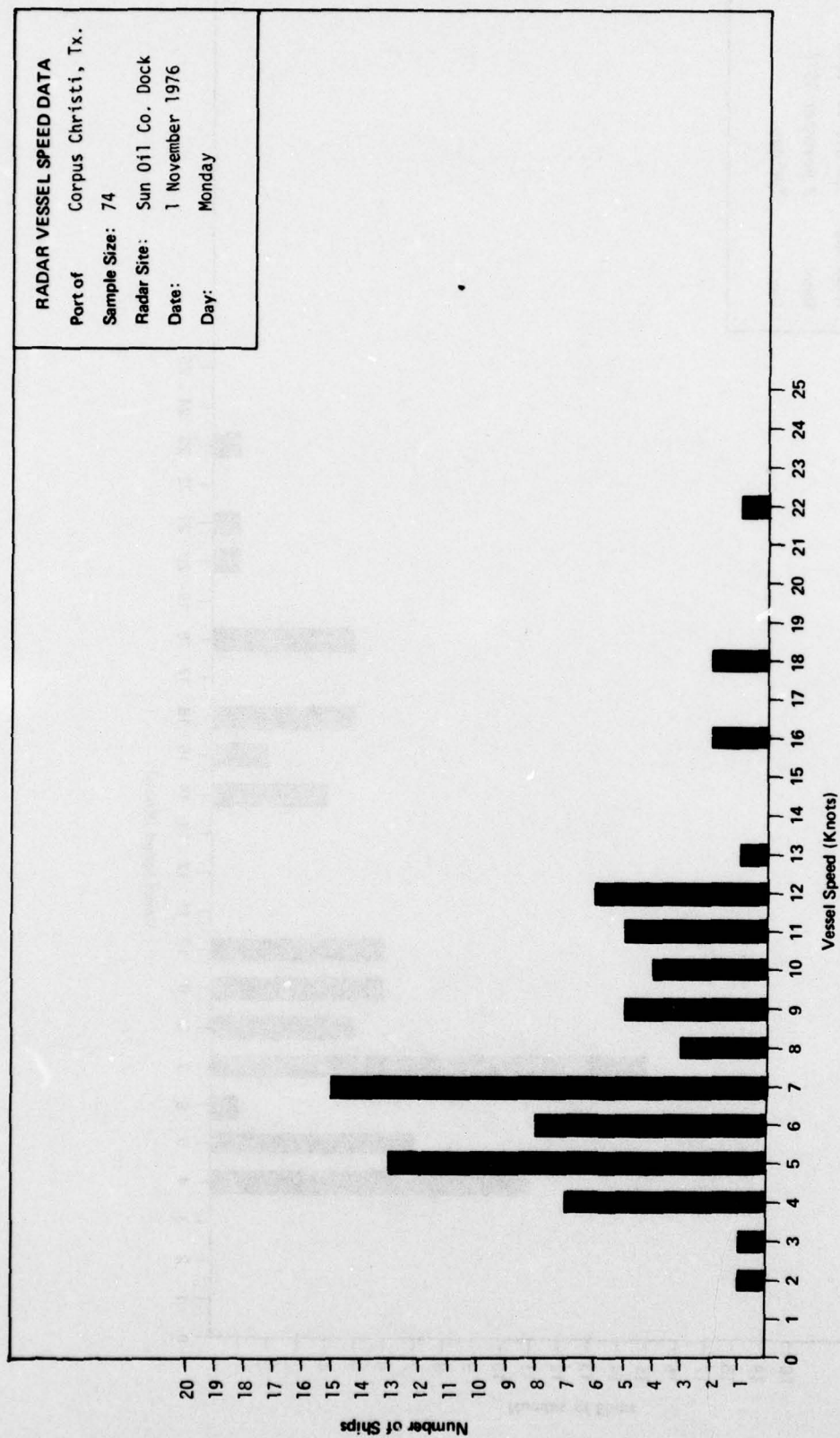


FIGURE 2-12

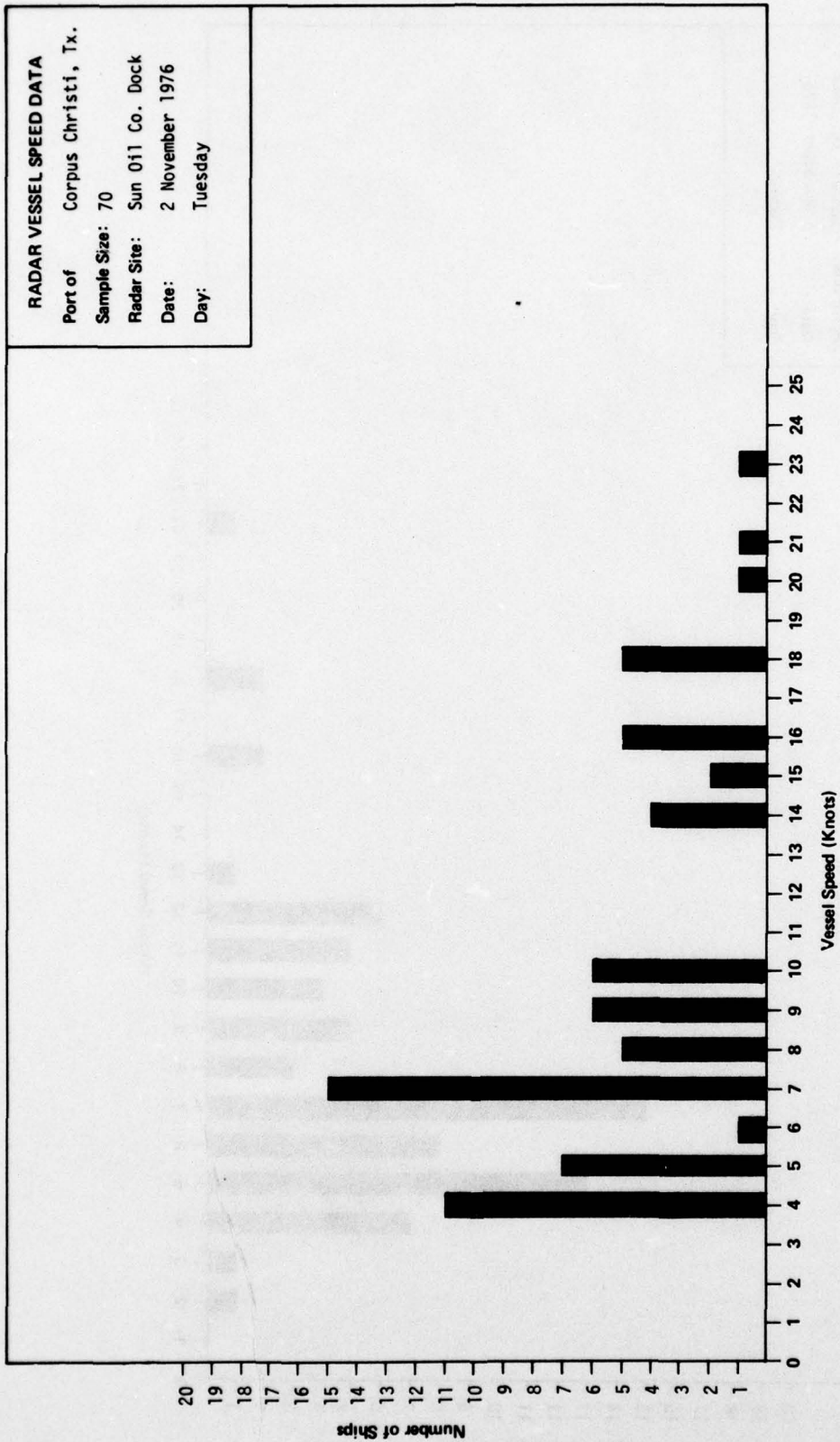


FIGURE 2-13

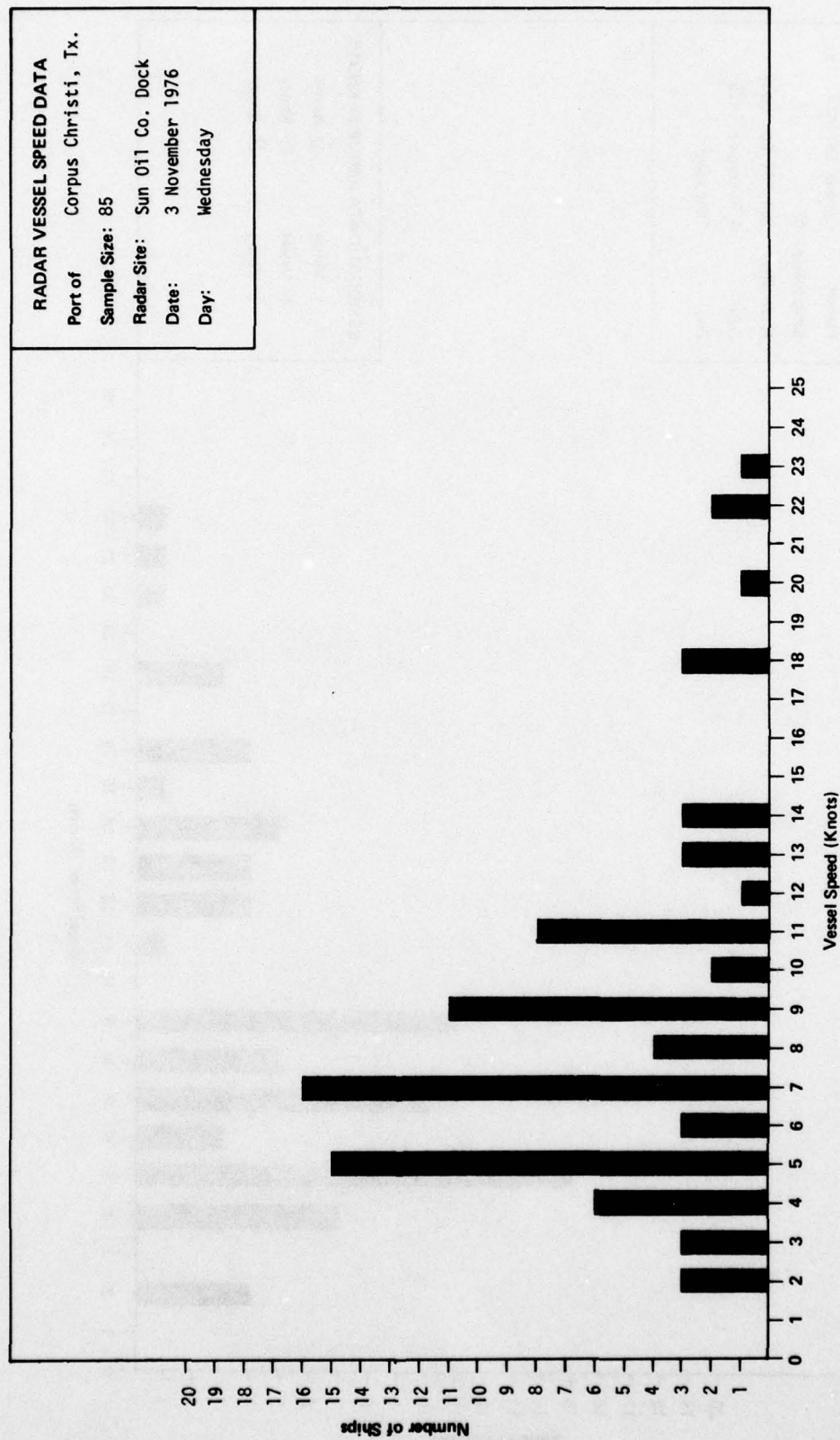


FIGURE 2-14

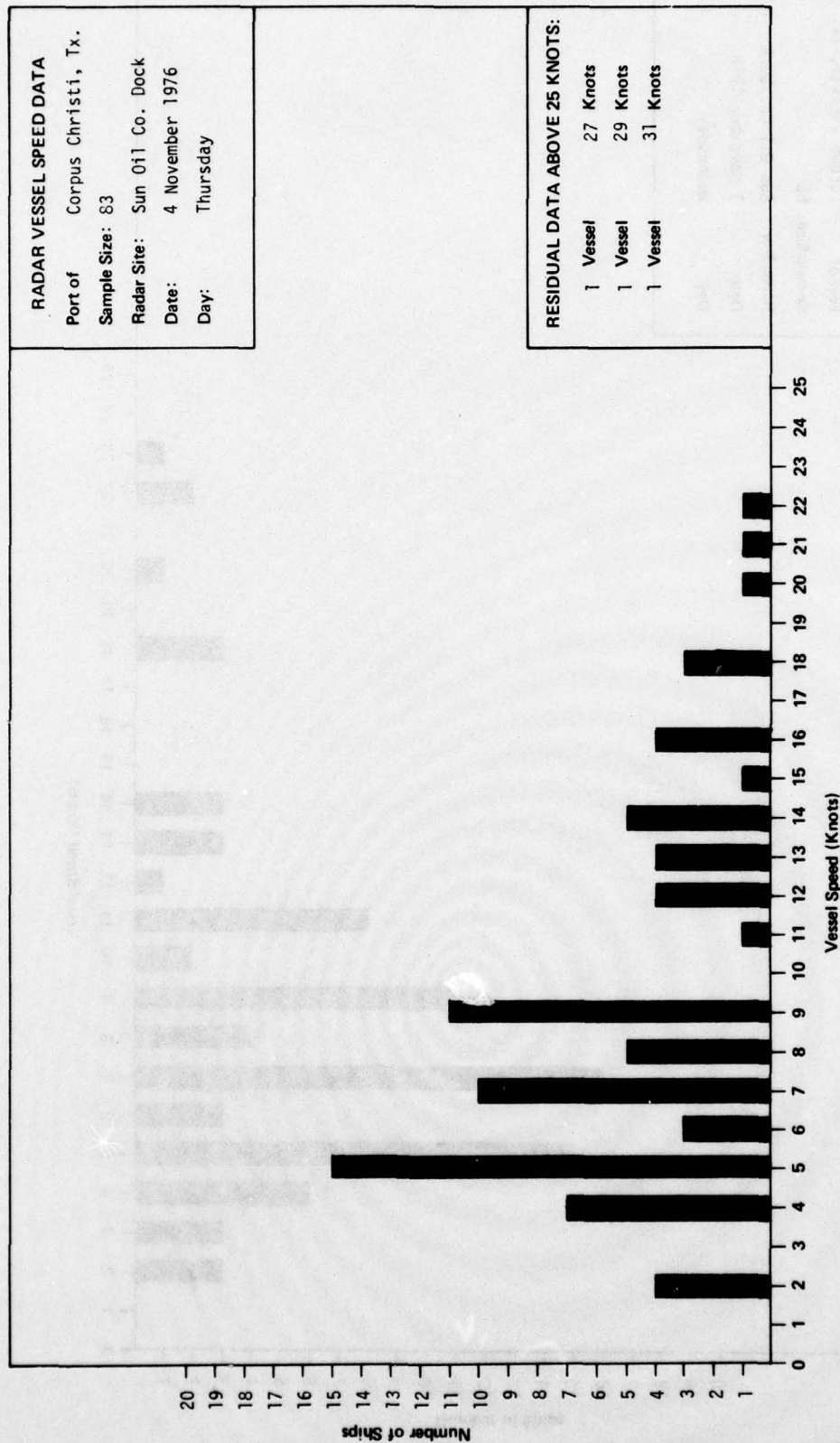


FIGURE 2-15

RADAR VESSEL SPEED DATA
 Port of Corpus Christi, Tx.
 Sample Size: 40
 Radar Site: Sun Oil Co. Dock
 Date: 5 November 1976
 Day: Friday

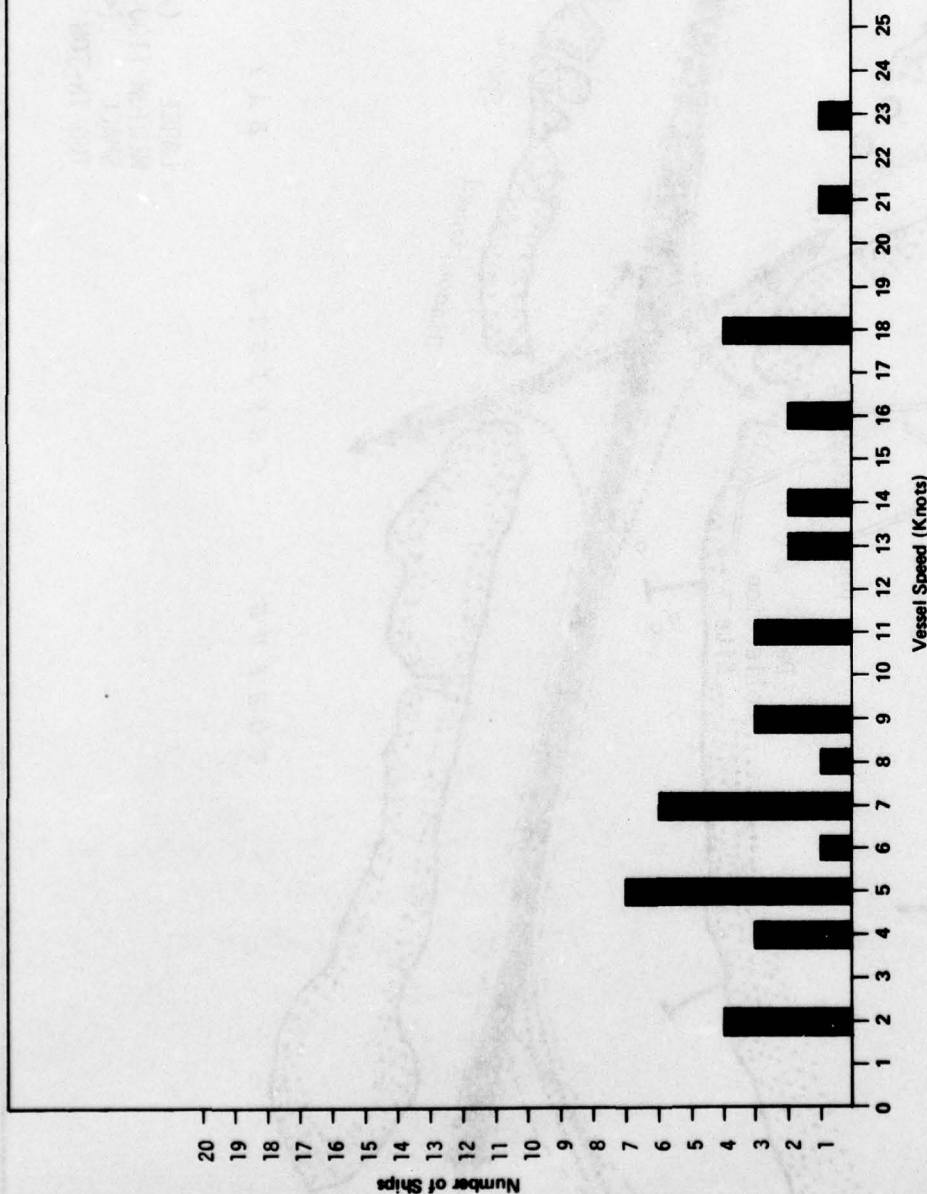


FIGURE 2-16

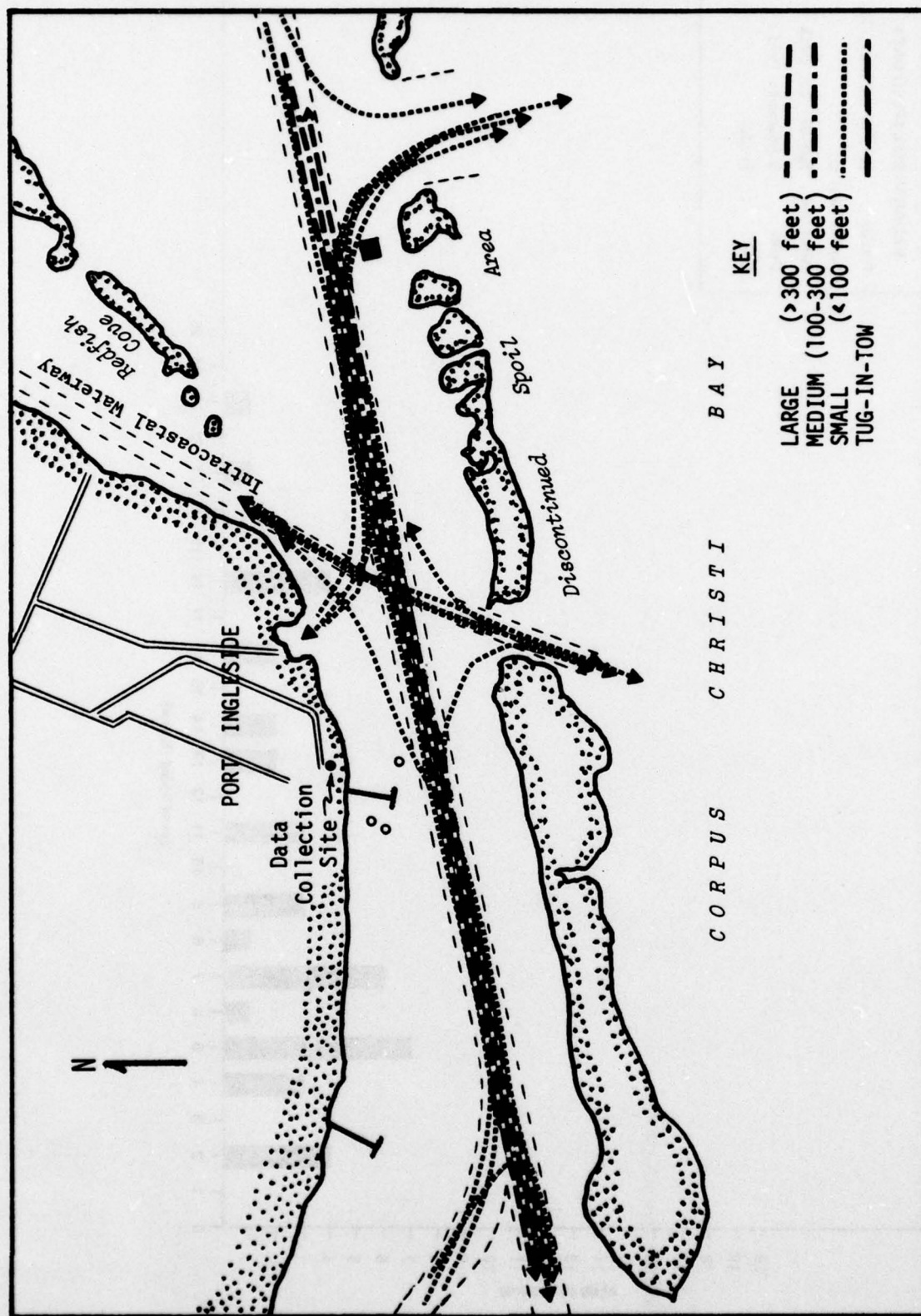


FIGURE 2-17: ROUTE IDENTIFICATION AT CORPUS CHRISTI,
0000-0930, MONDAY, 1 NOVEMBER 1976

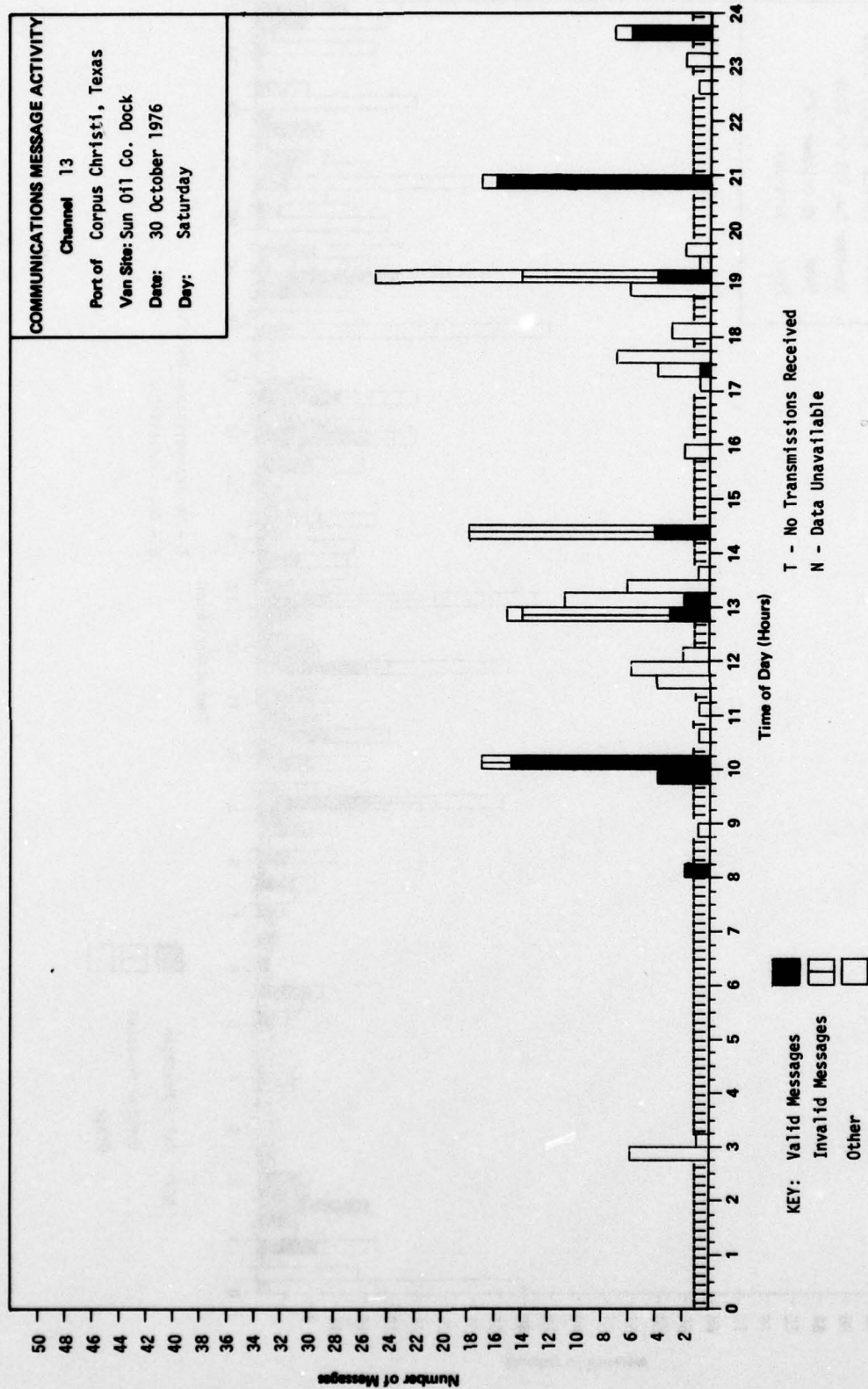


FIGURE 2-18

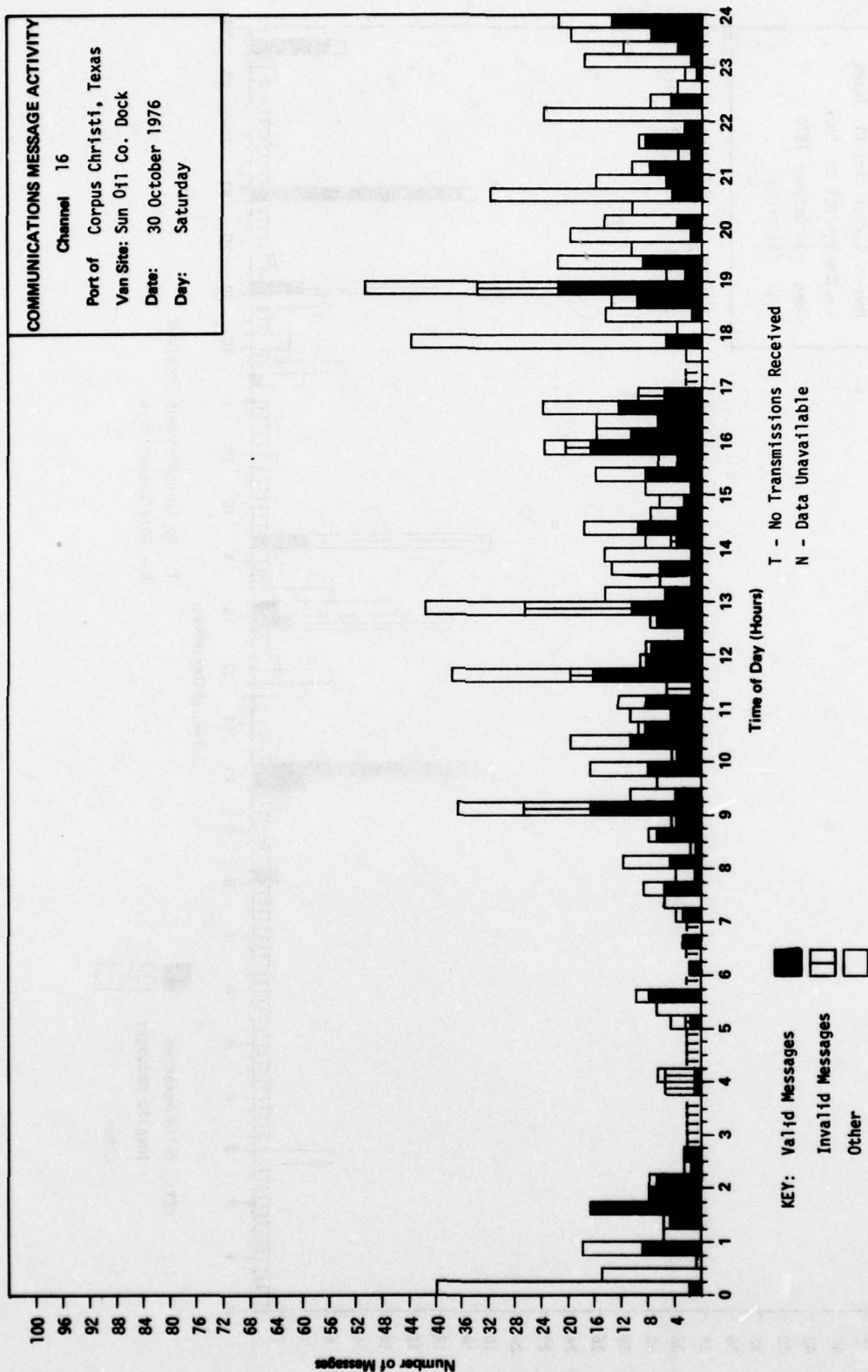


FIGURE 2-19

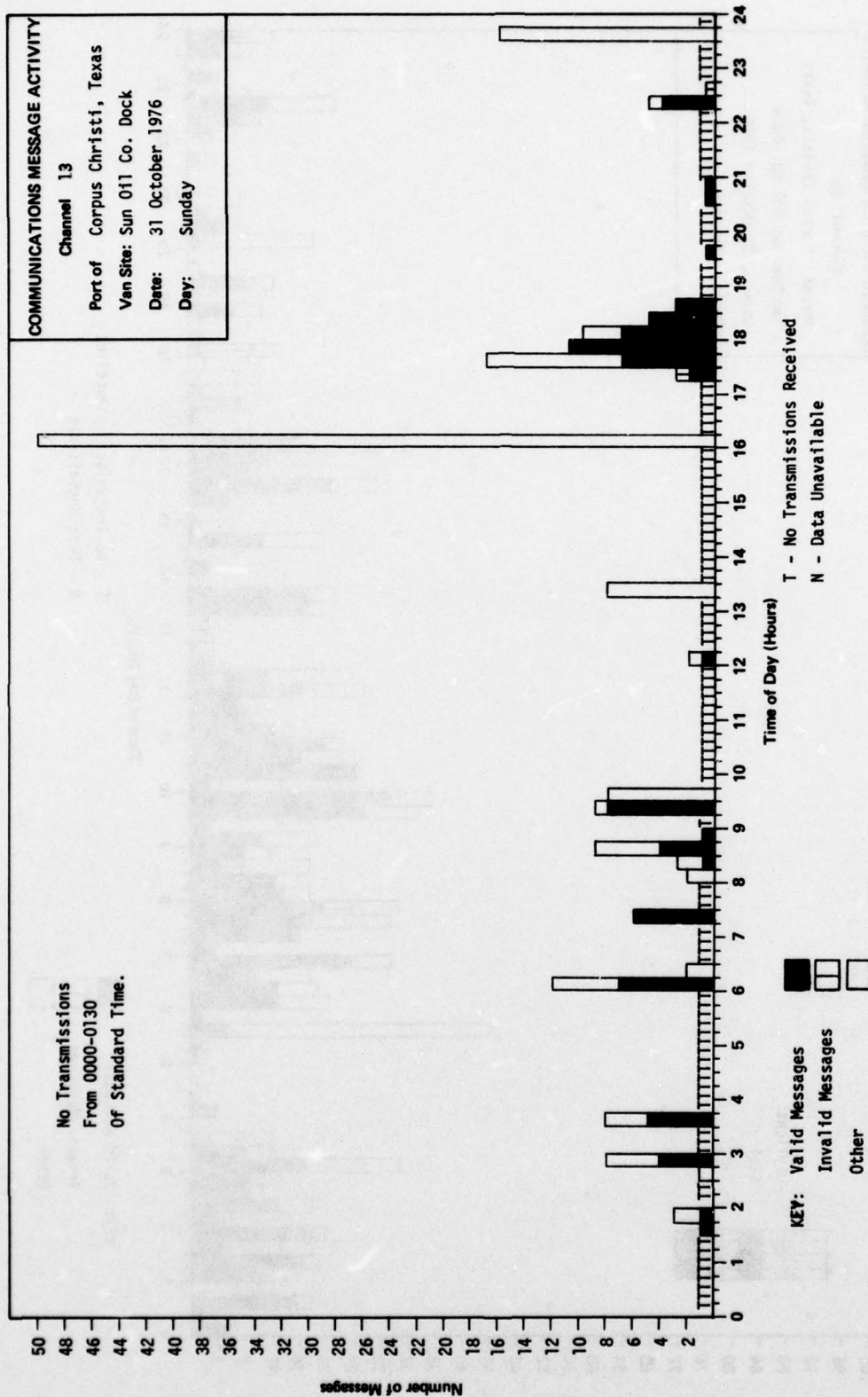


FIGURE 2-20

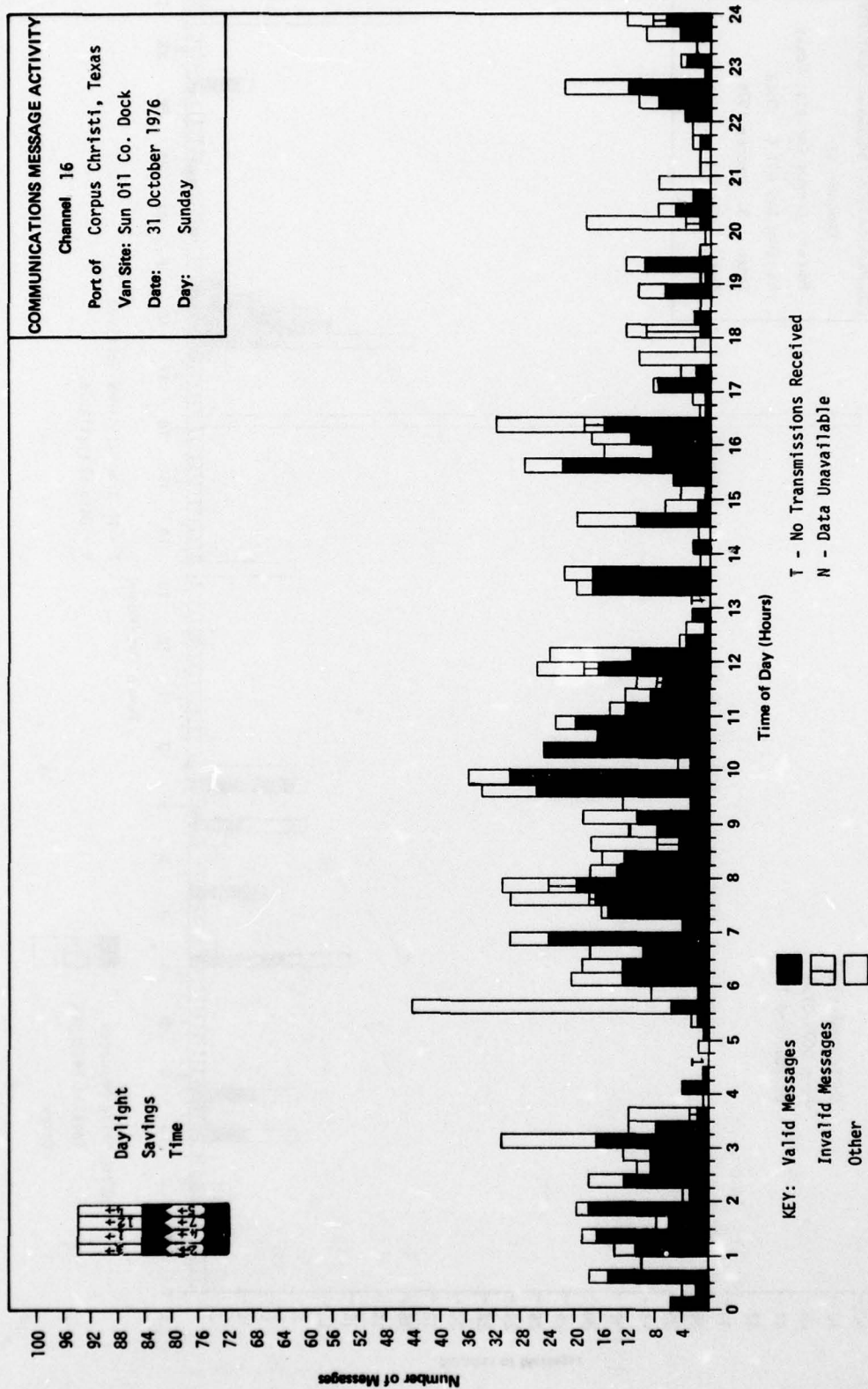


FIGURE 2-21

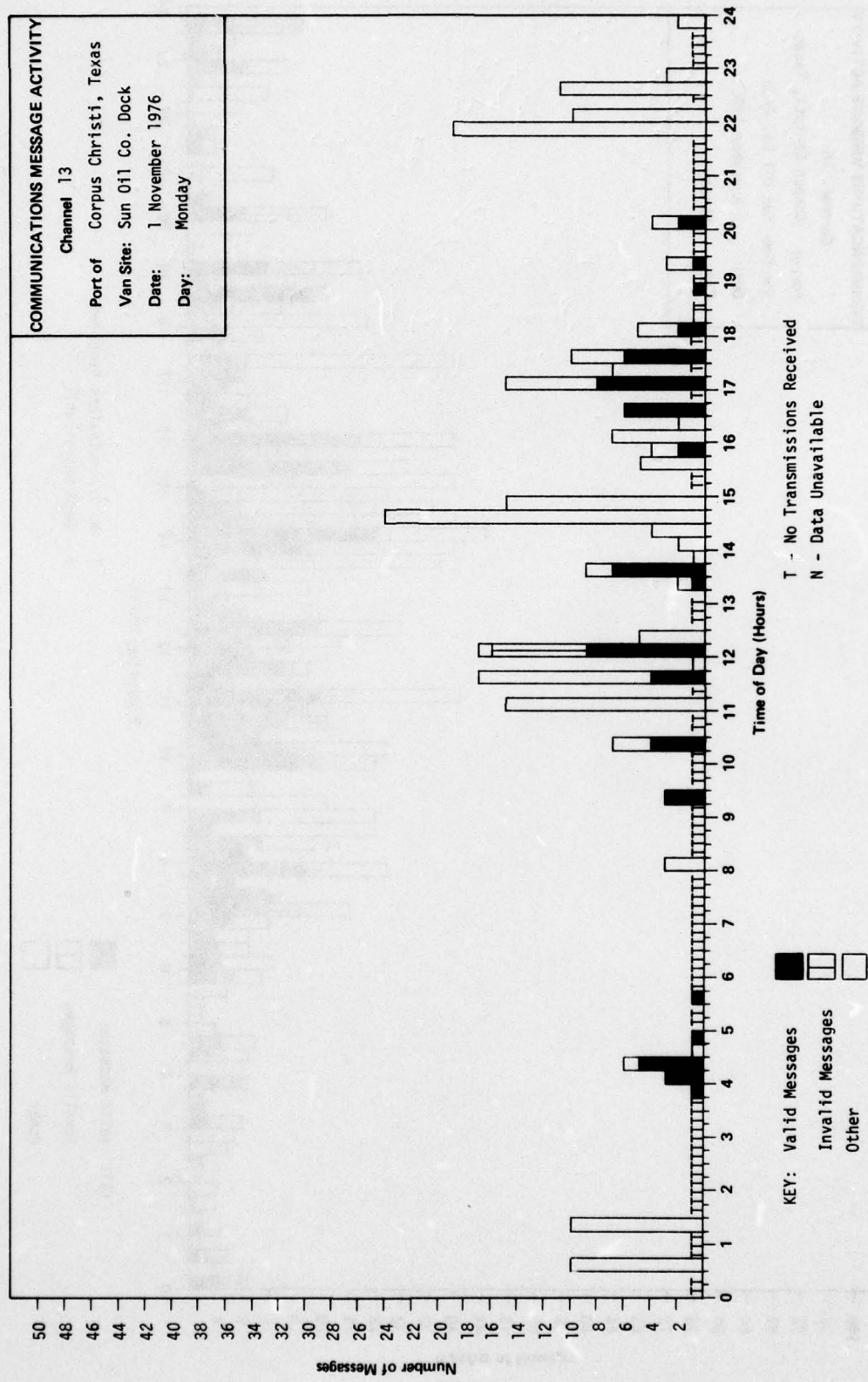


FIGURE 2-22

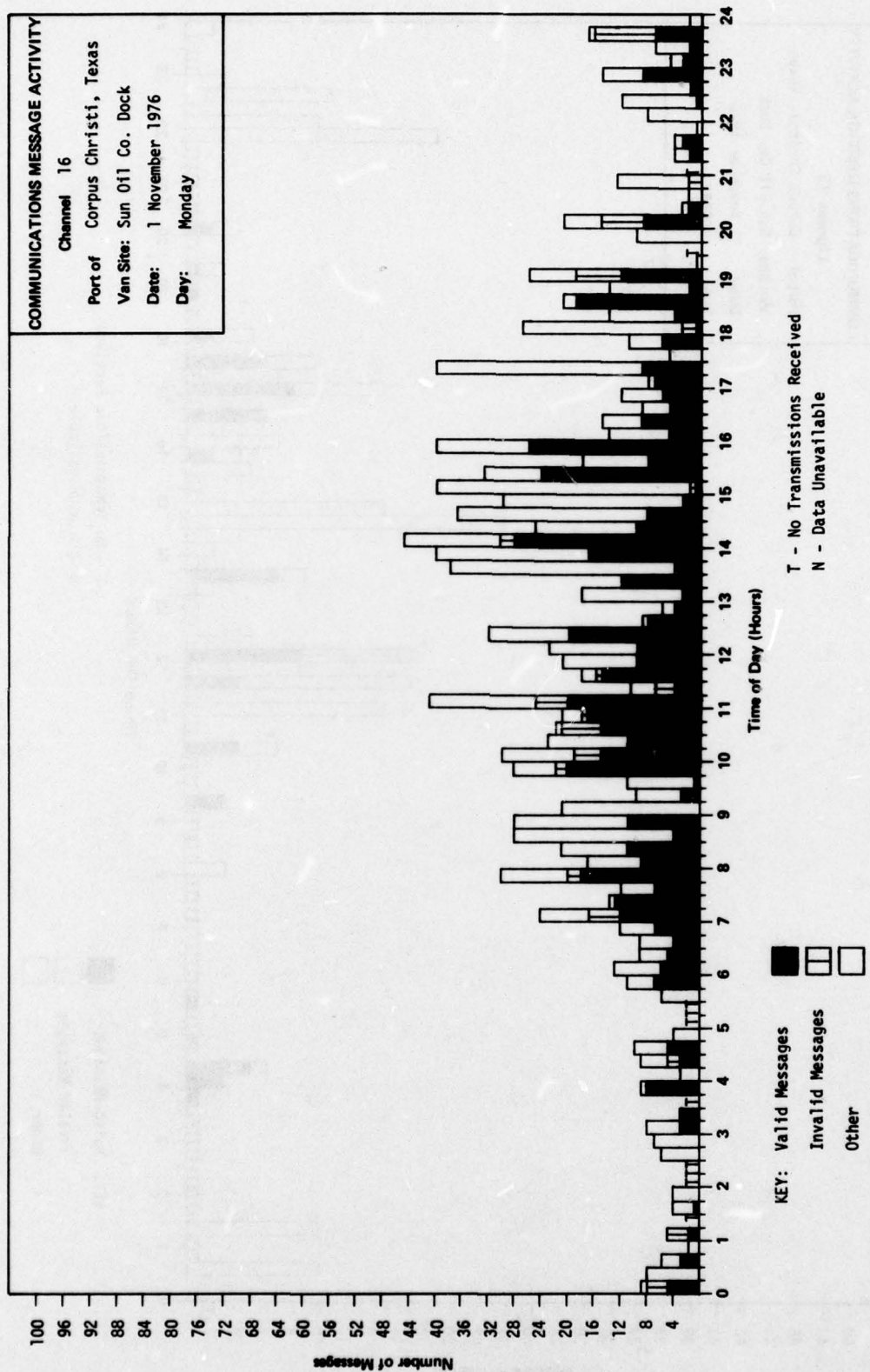


FIGURE 2-23

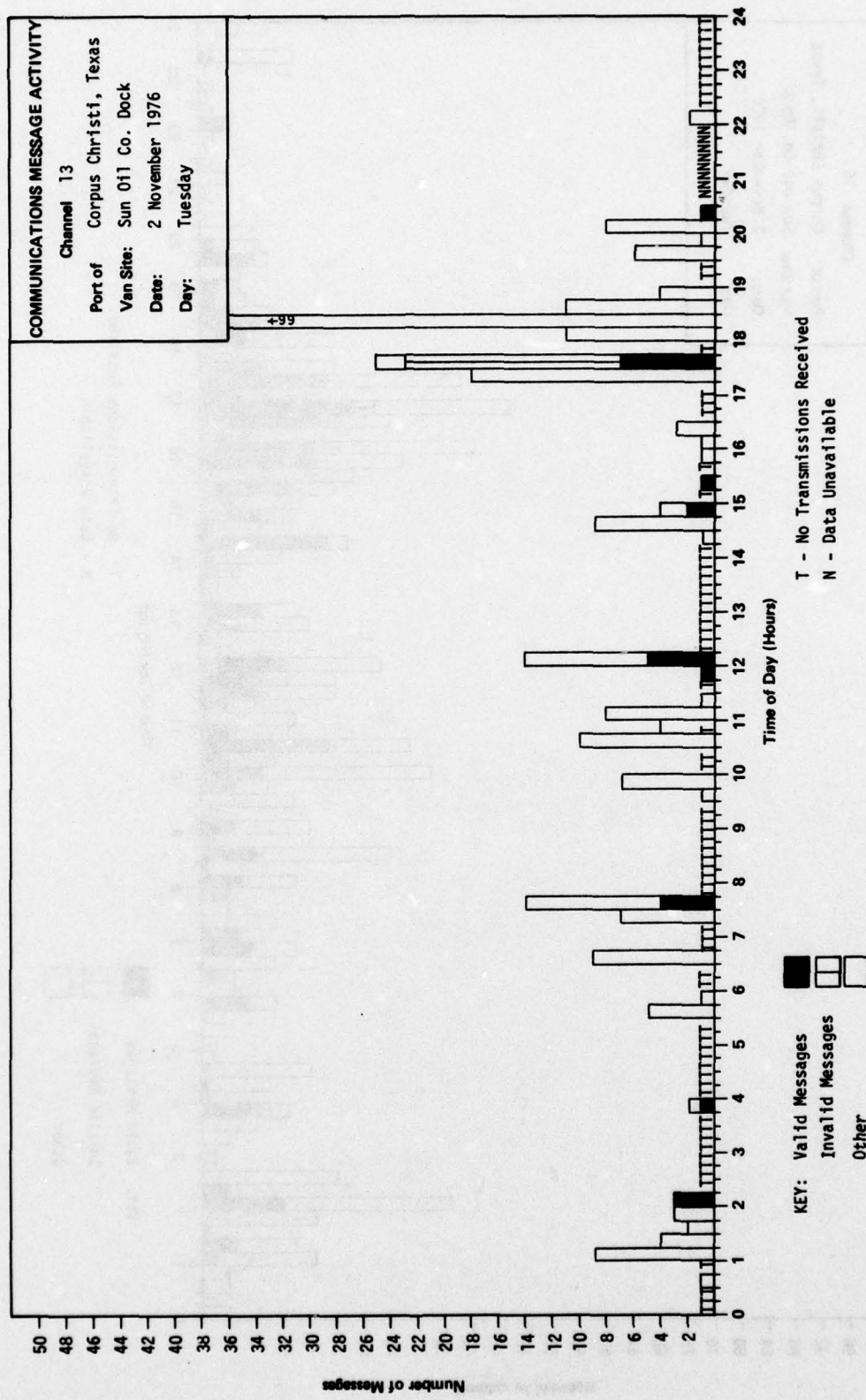


FIGURE 2-24

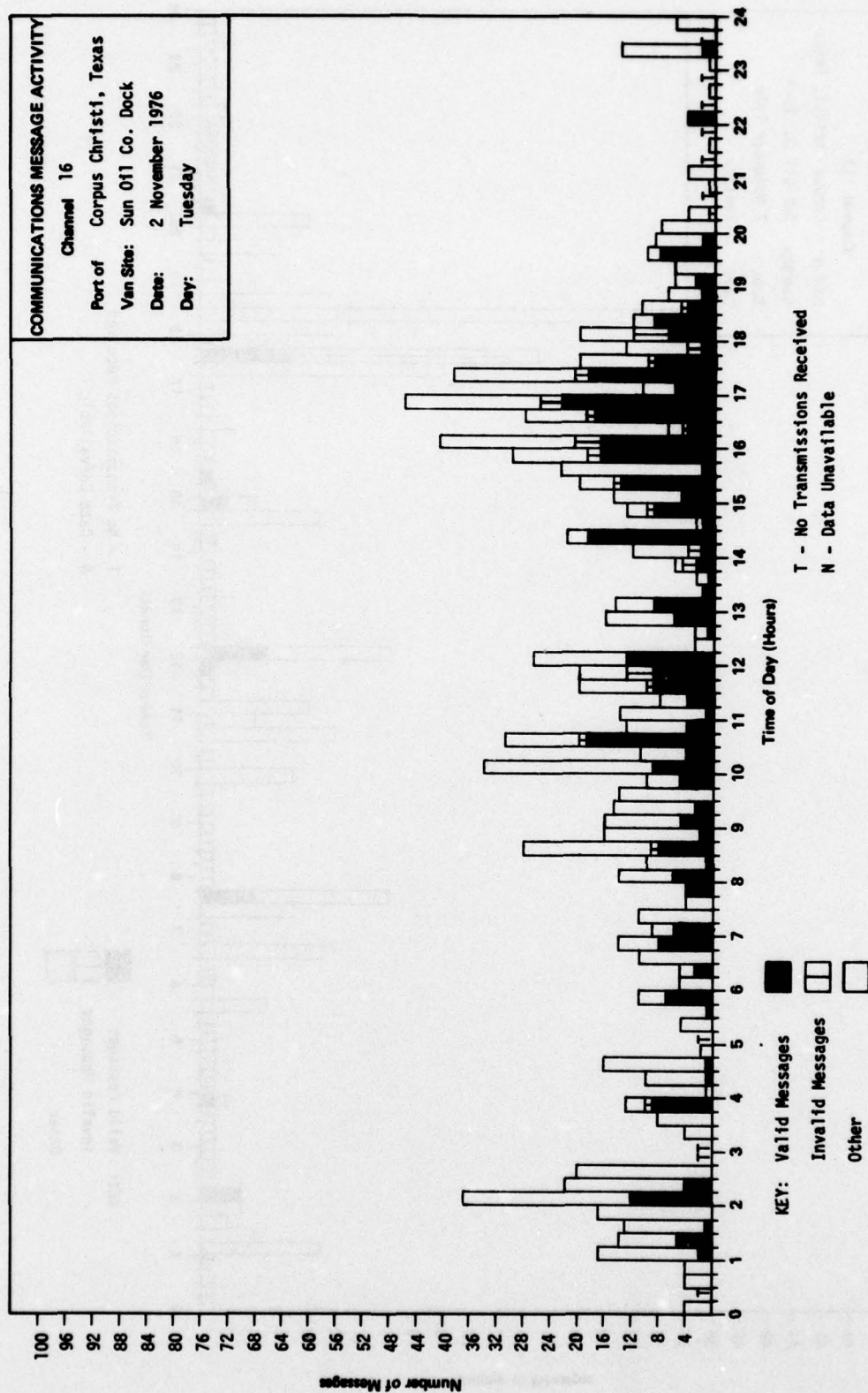


FIGURE 2-25

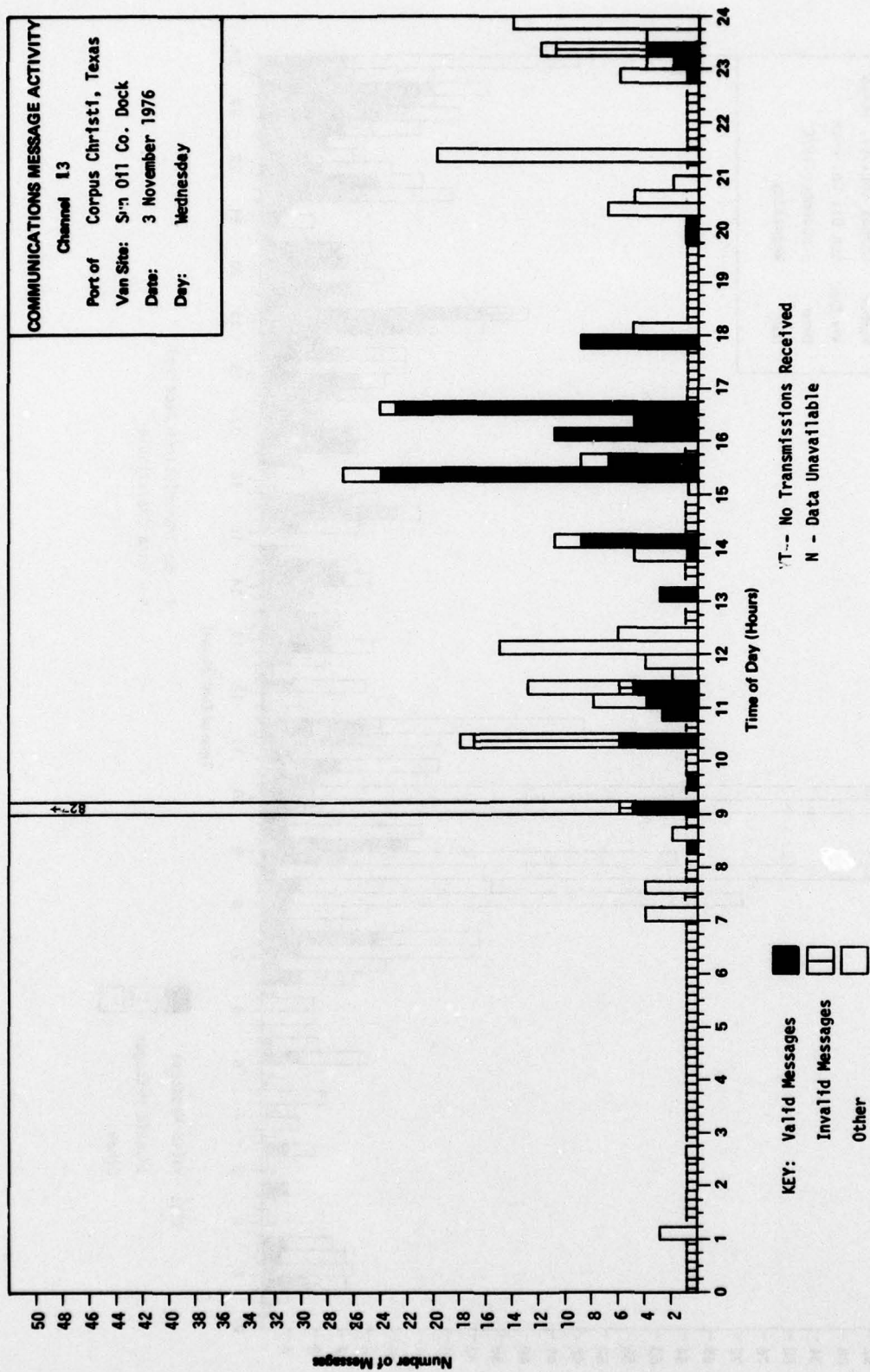


FIGURE 2-26

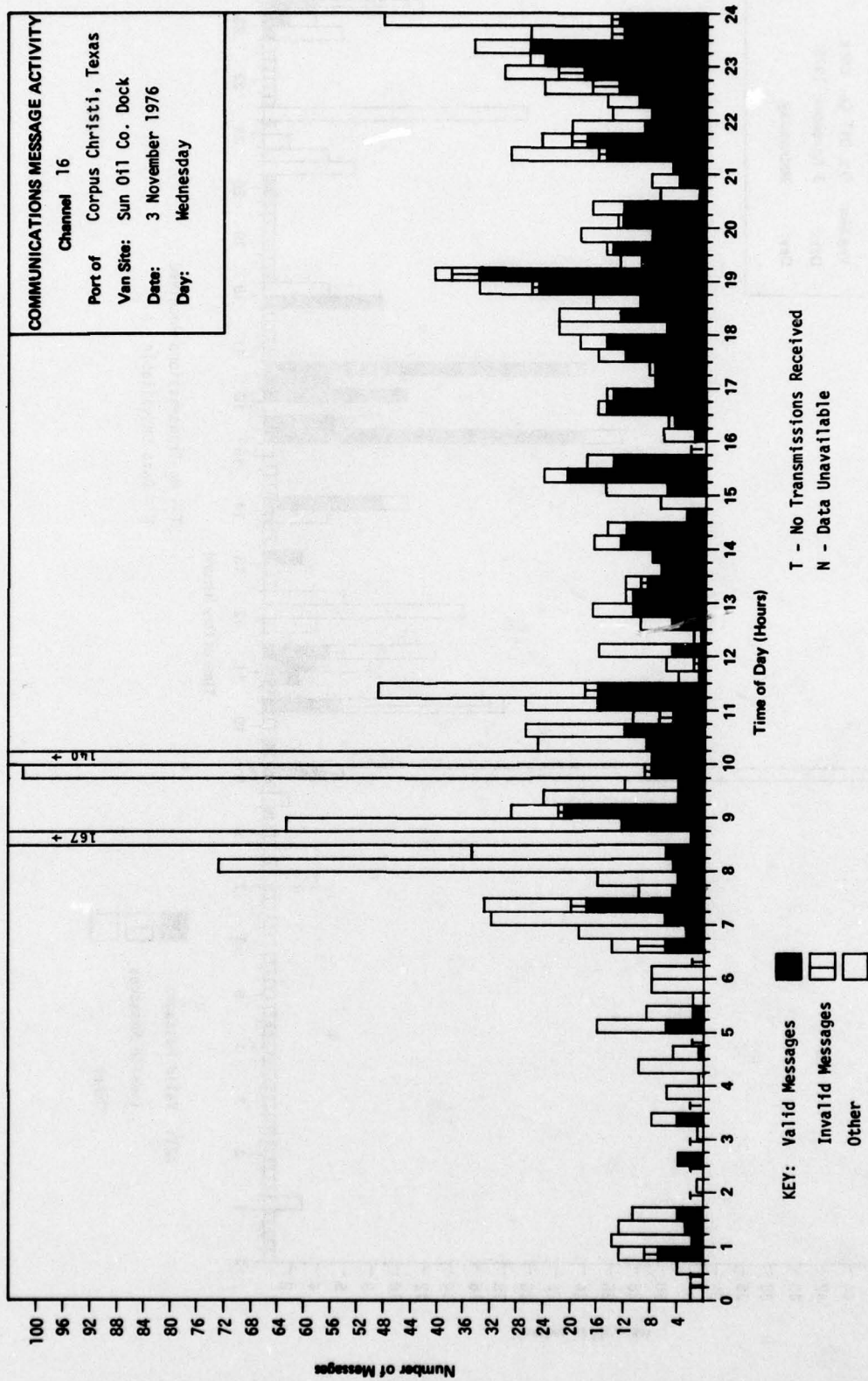


FIGURE 2-27

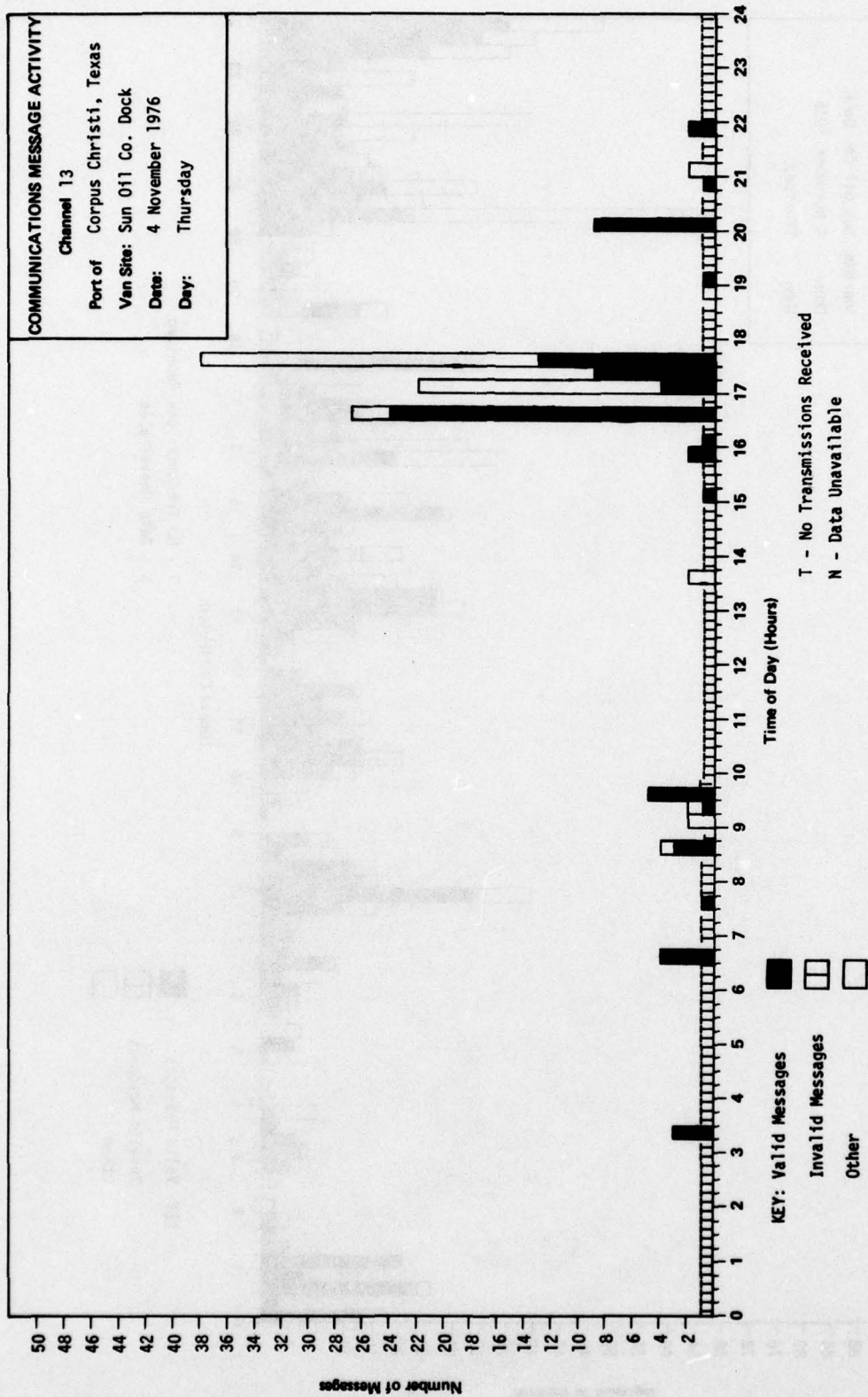


FIGURE 2-28

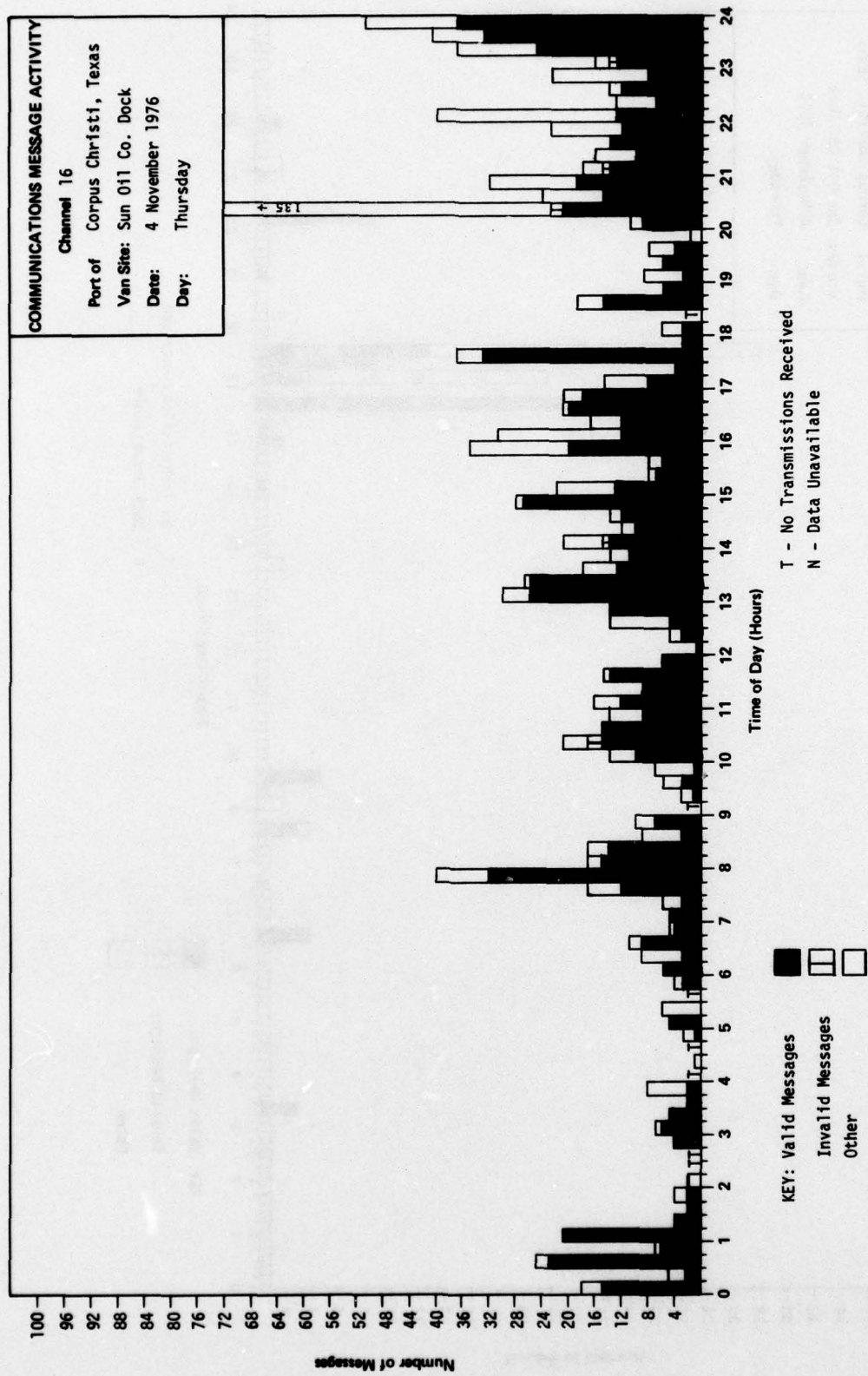


FIGURE 2-29

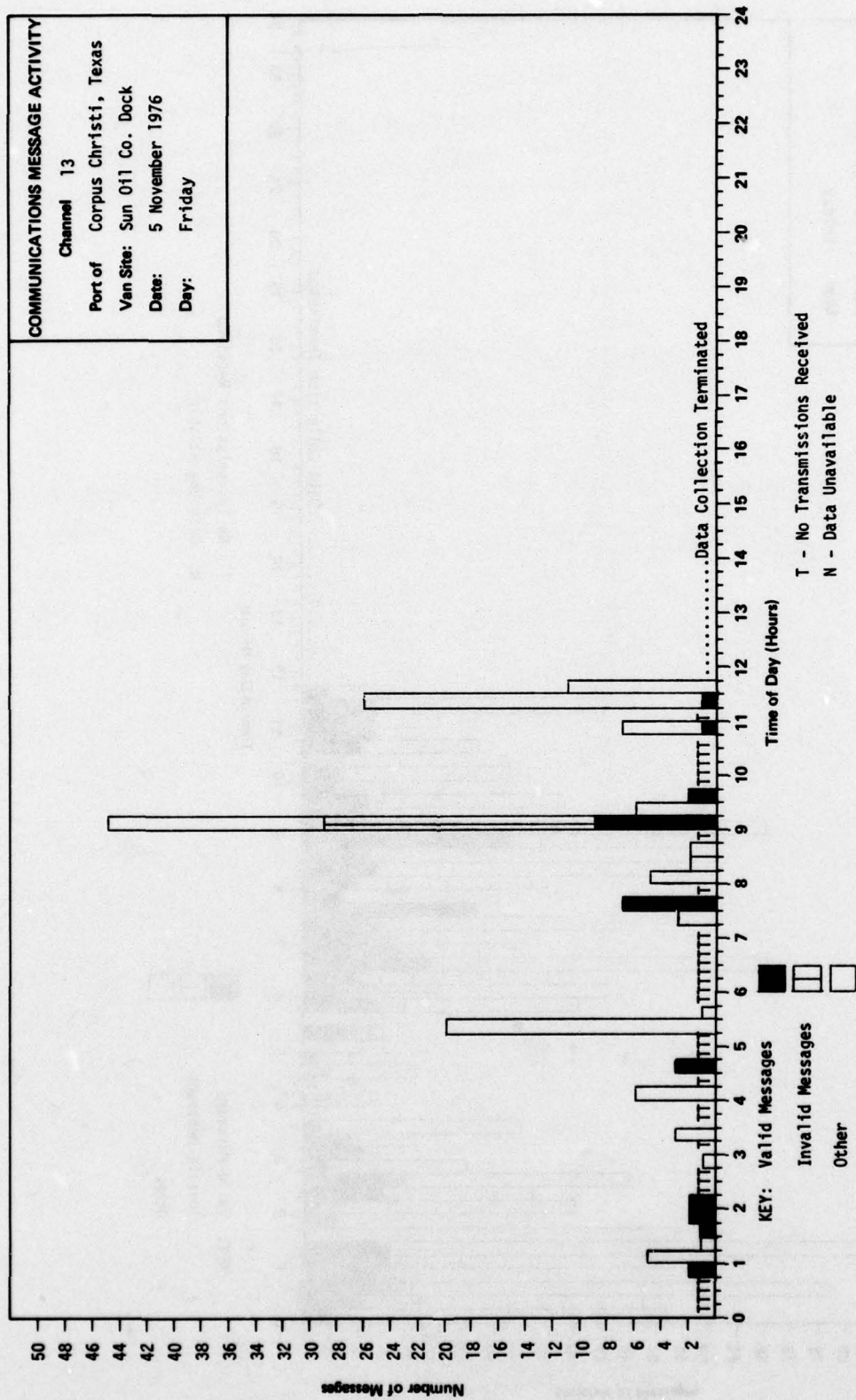


FIGURE 2-30

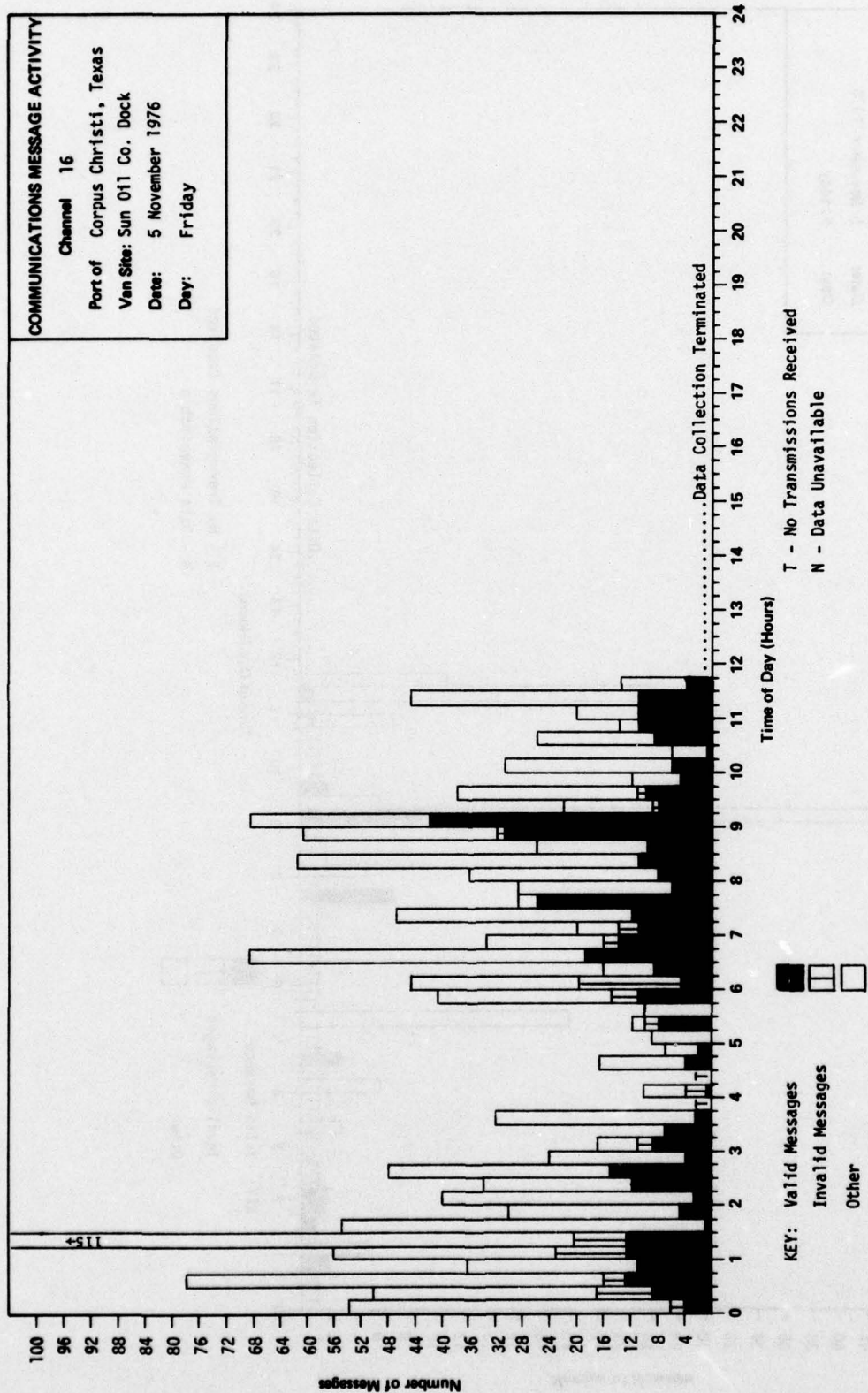


FIGURE 2-31

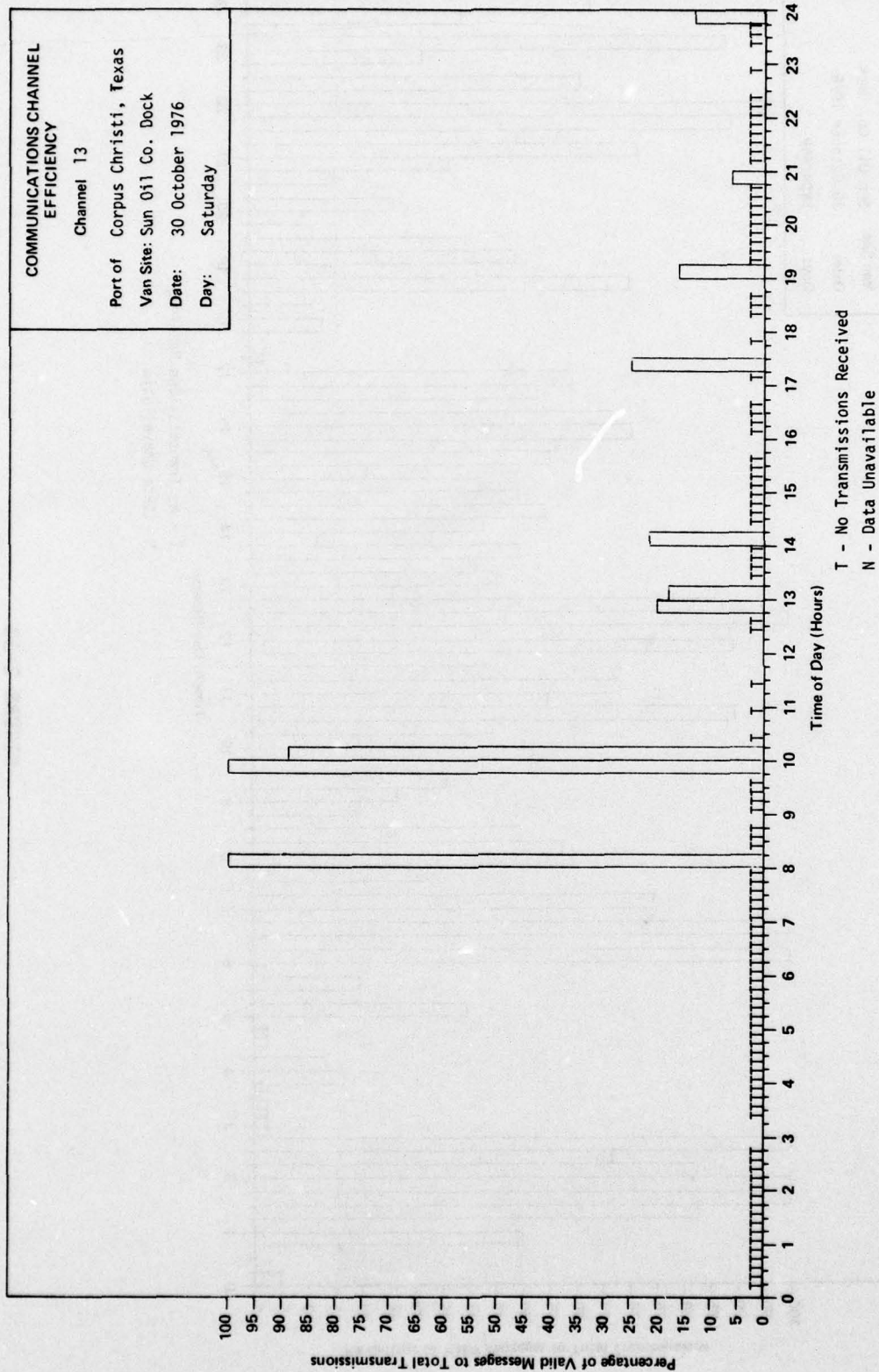


FIGURE 2-32

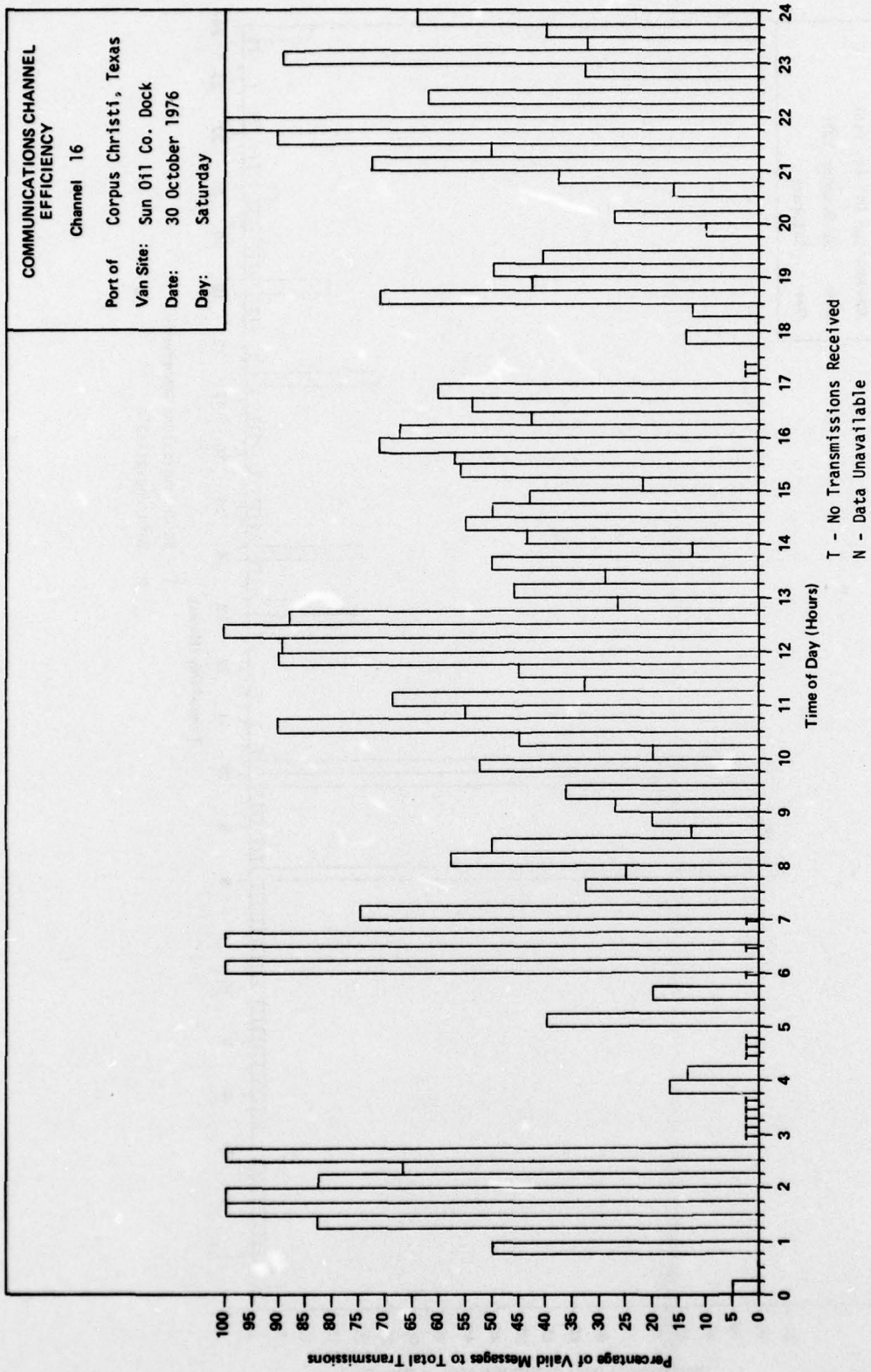


FIGURE 2-33

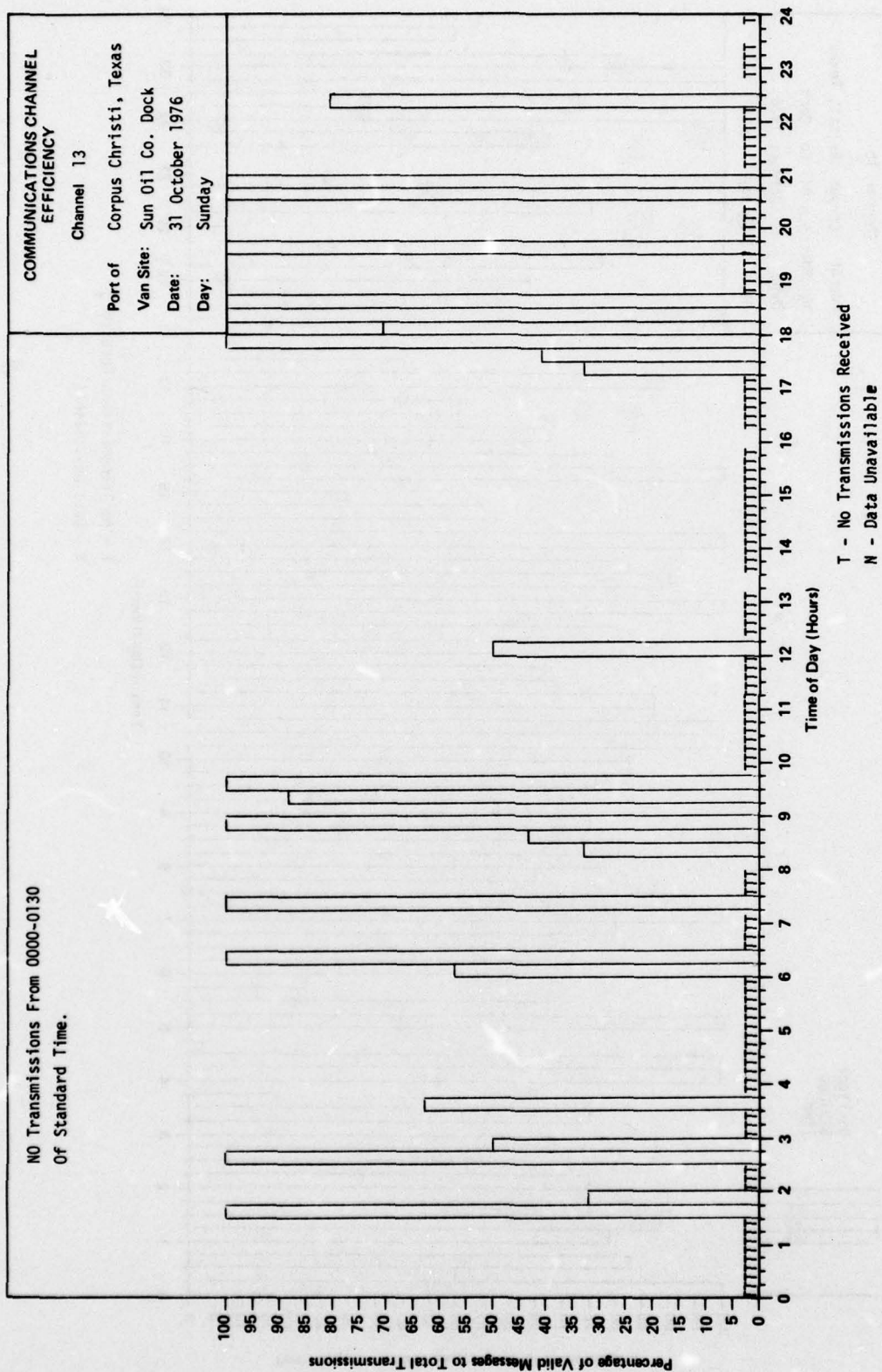


FIGURE 2-34

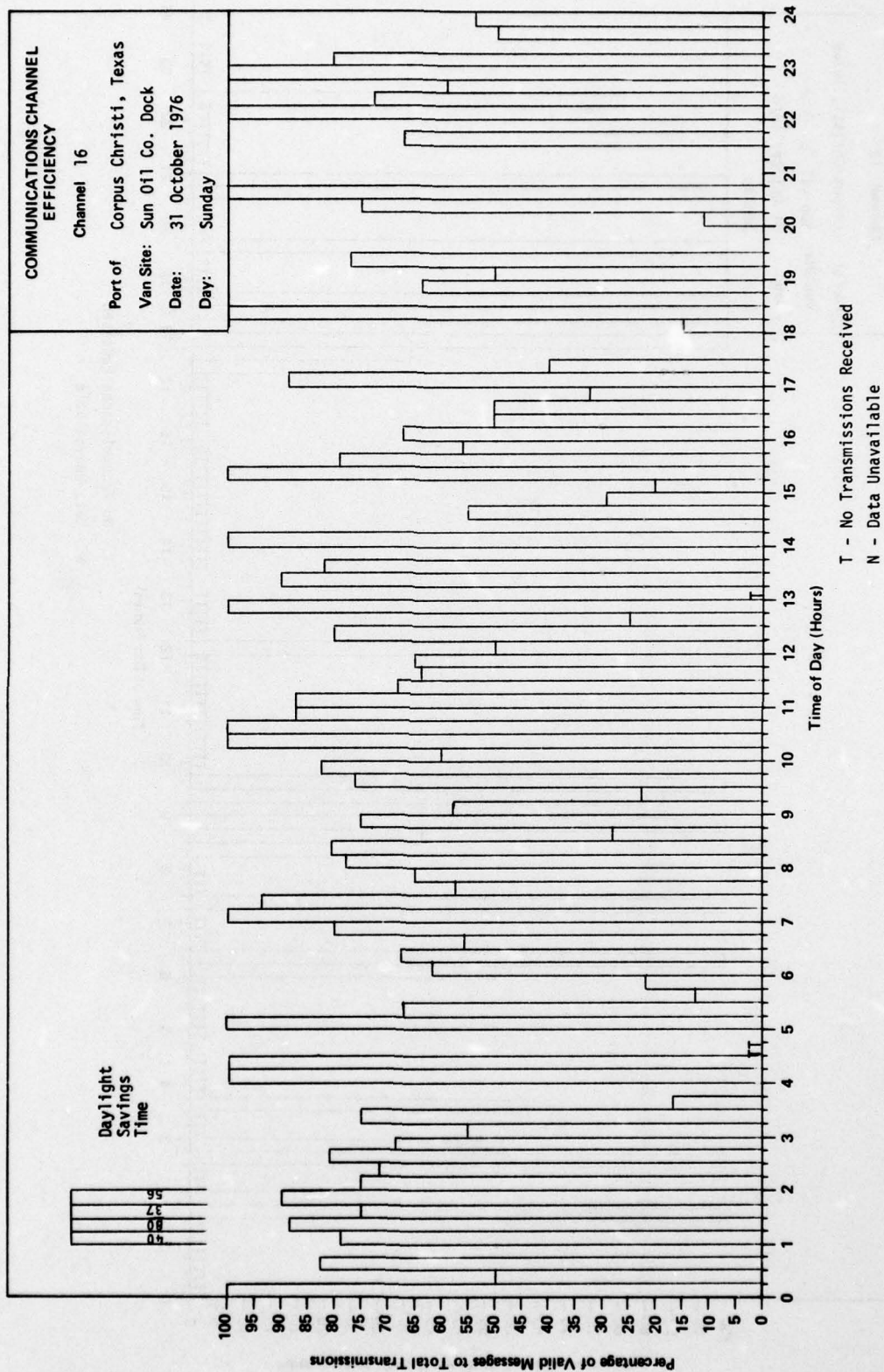


FIGURE 2-35

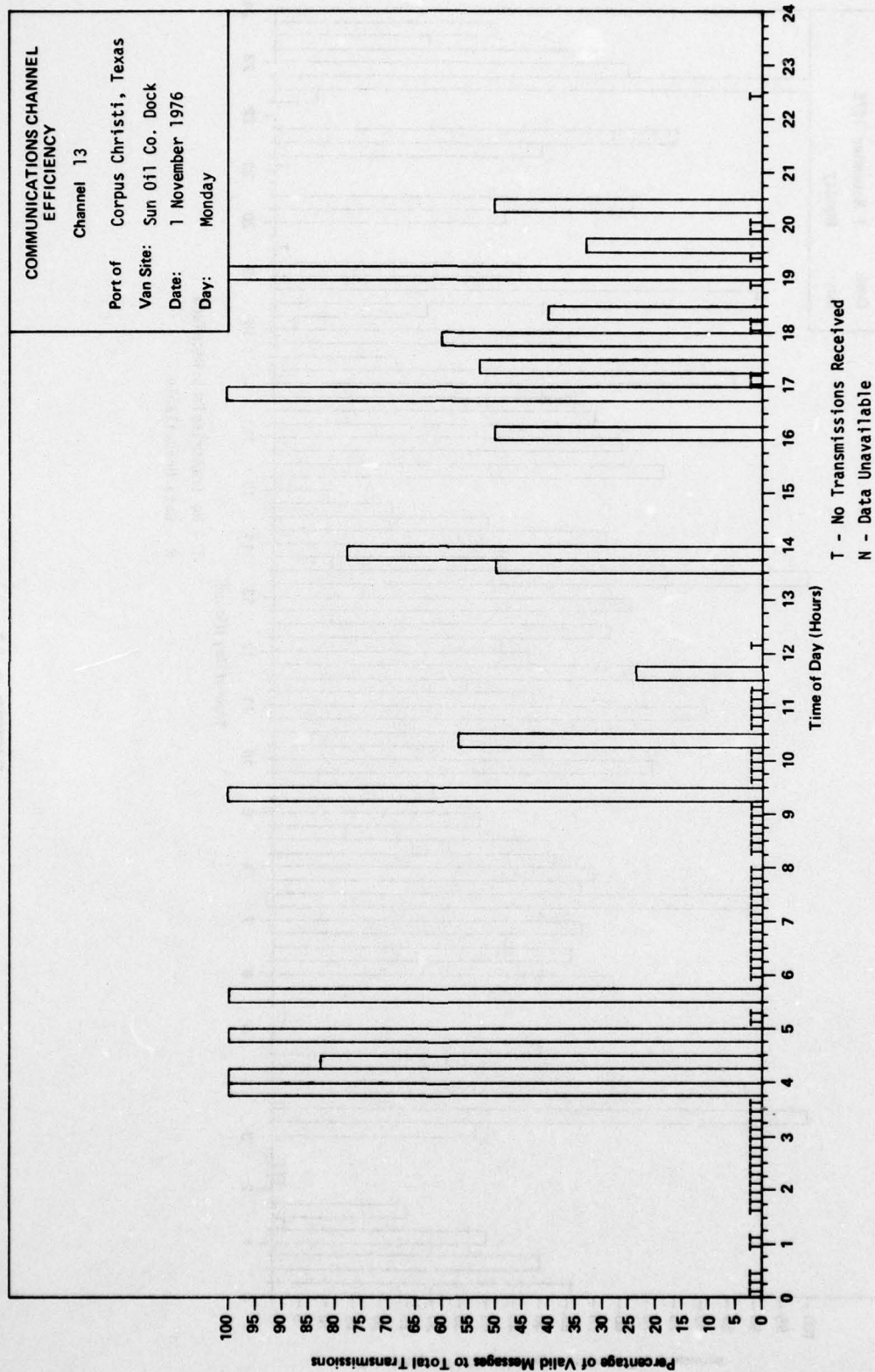


FIGURE 2-36

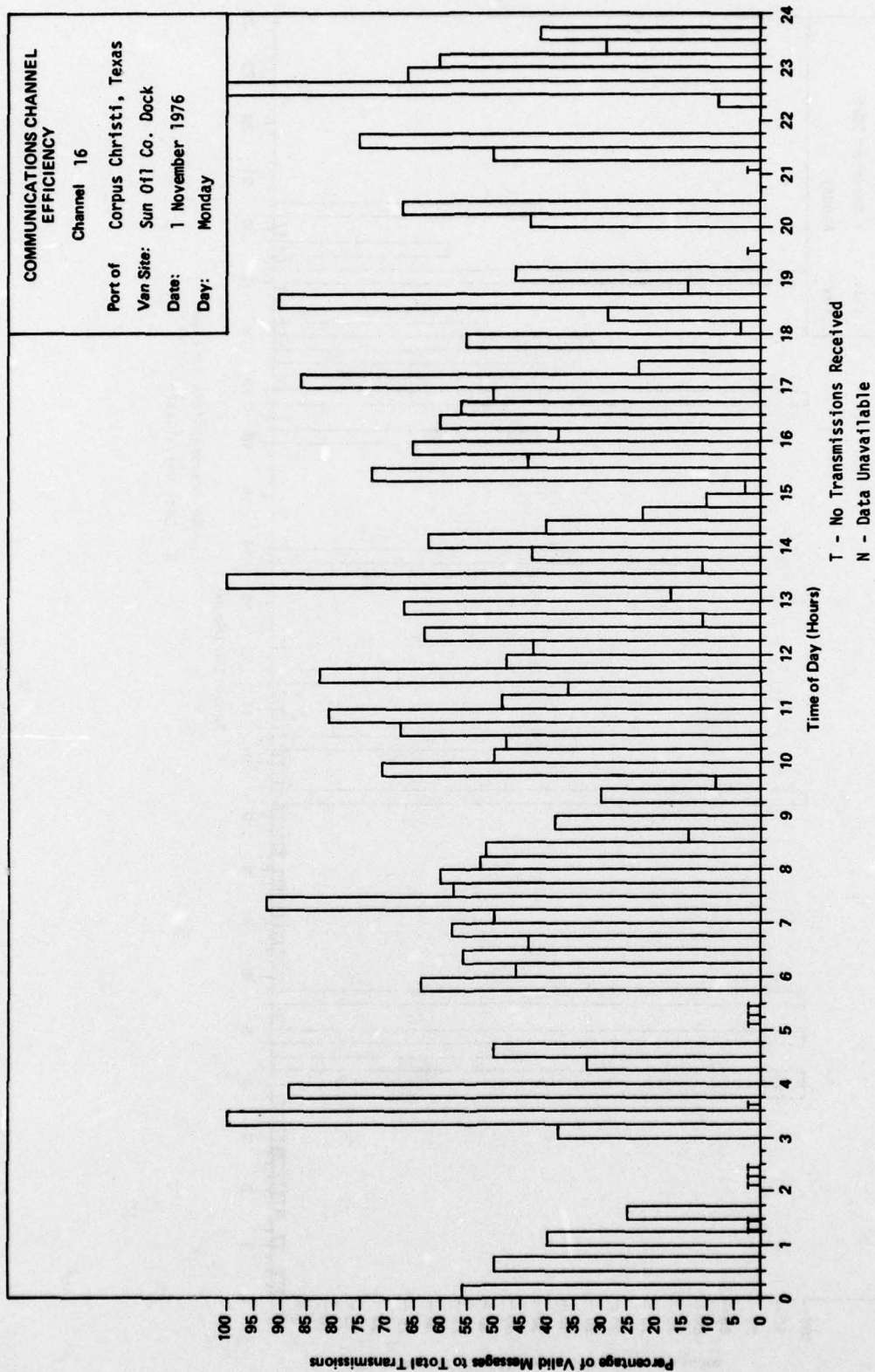


FIGURE 2-37

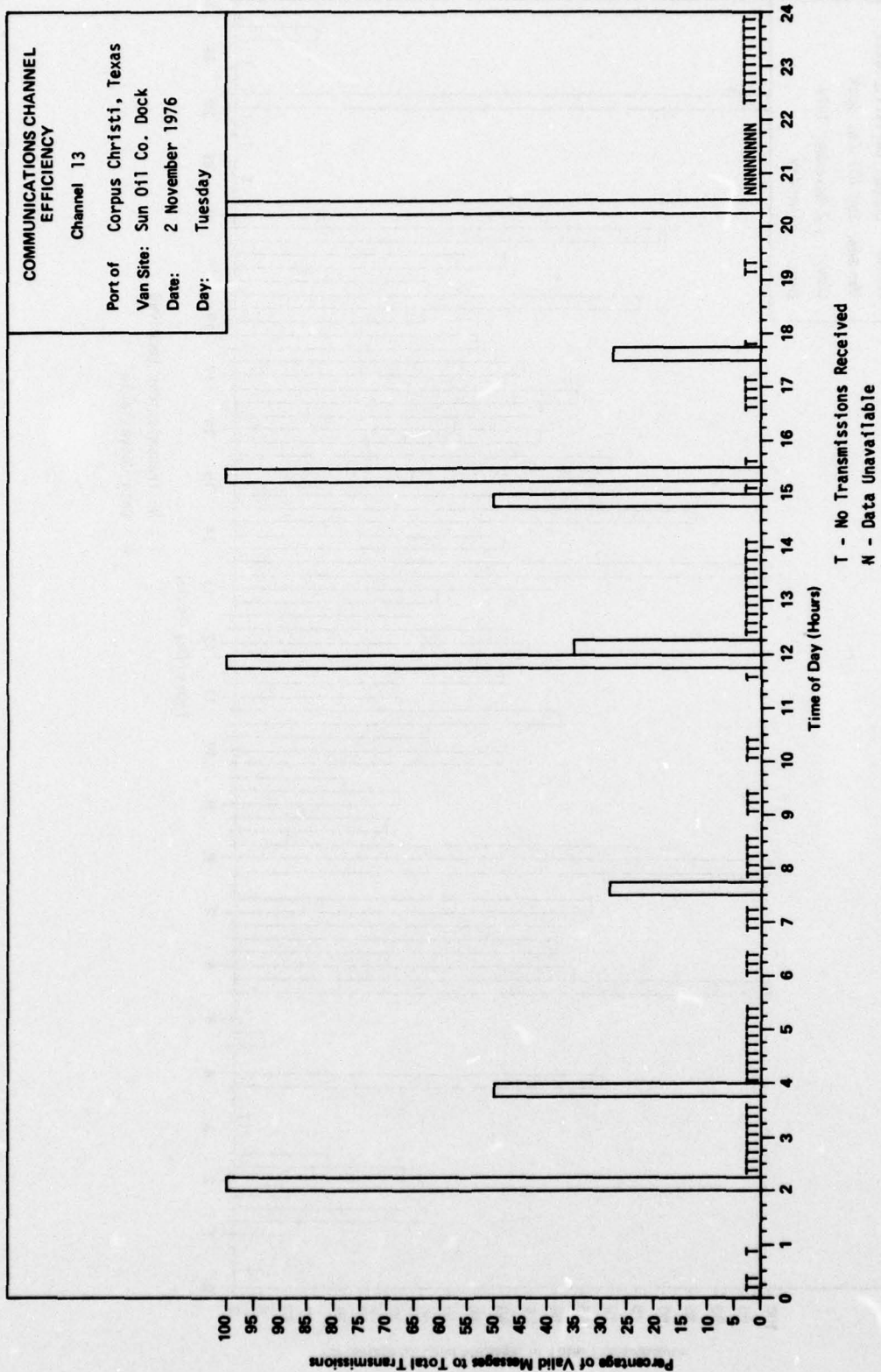


FIGURE 2-38

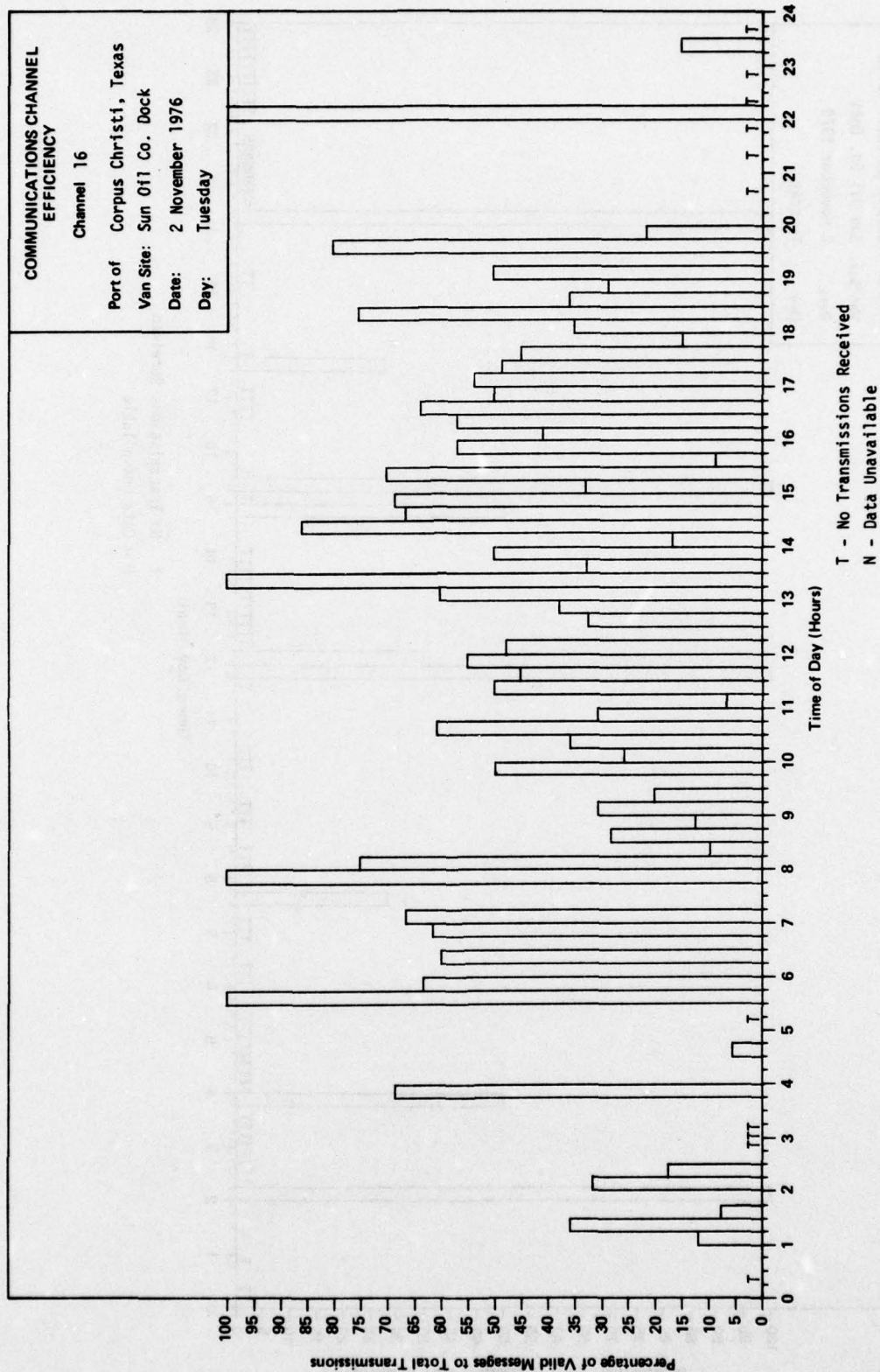


FIGURE 2-39

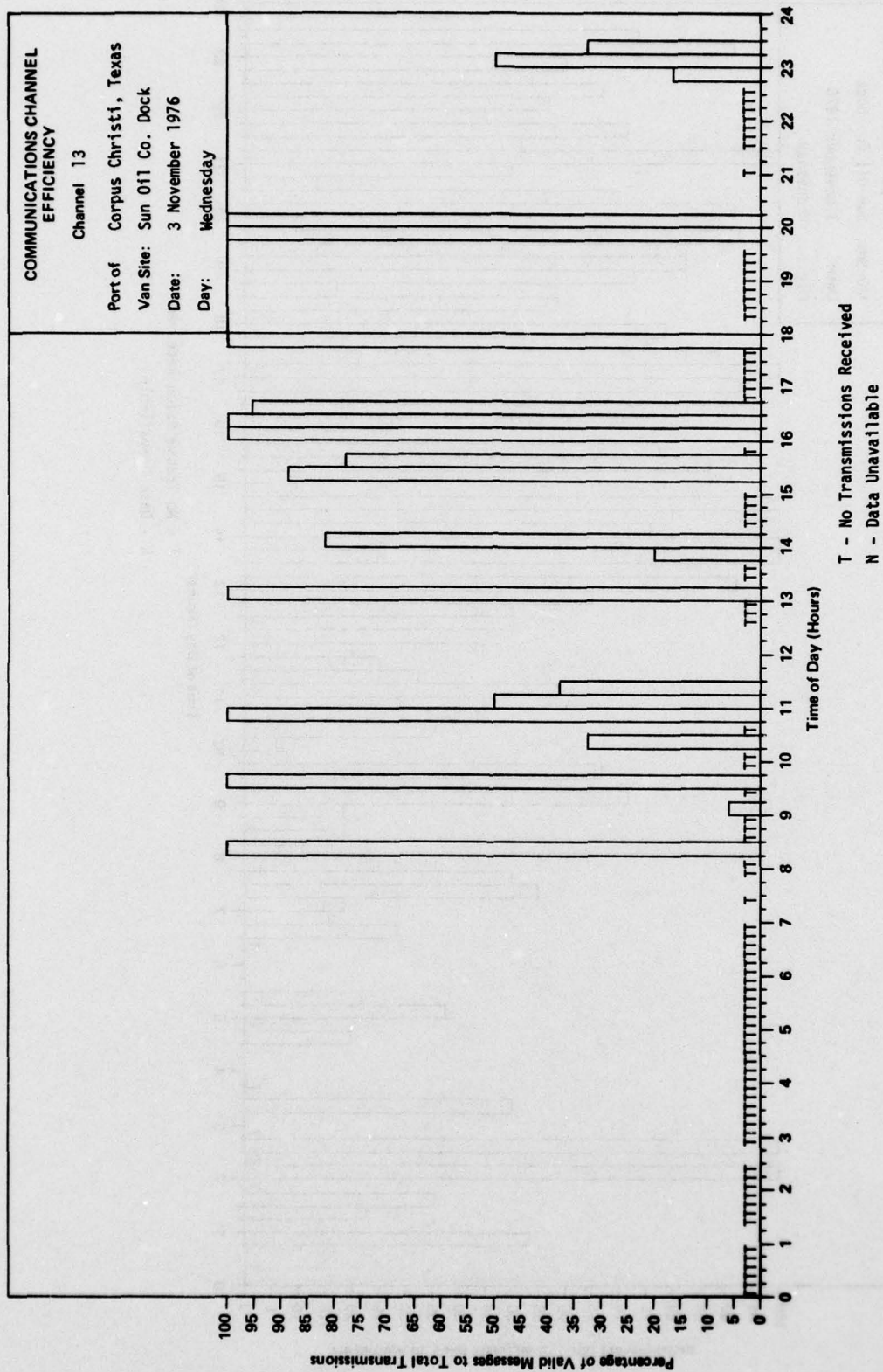


FIGURE 2-40

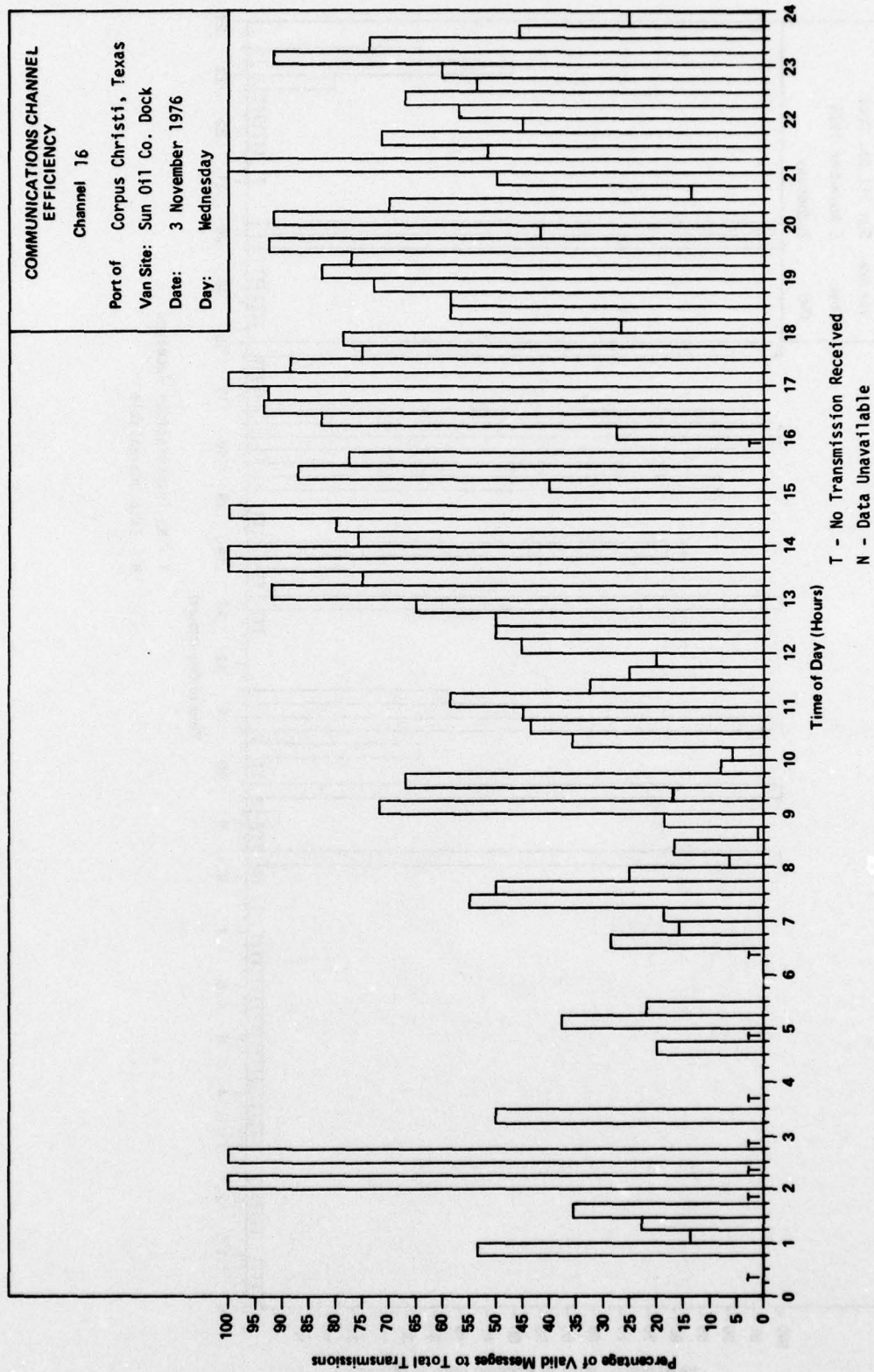


FIGURE 2-41

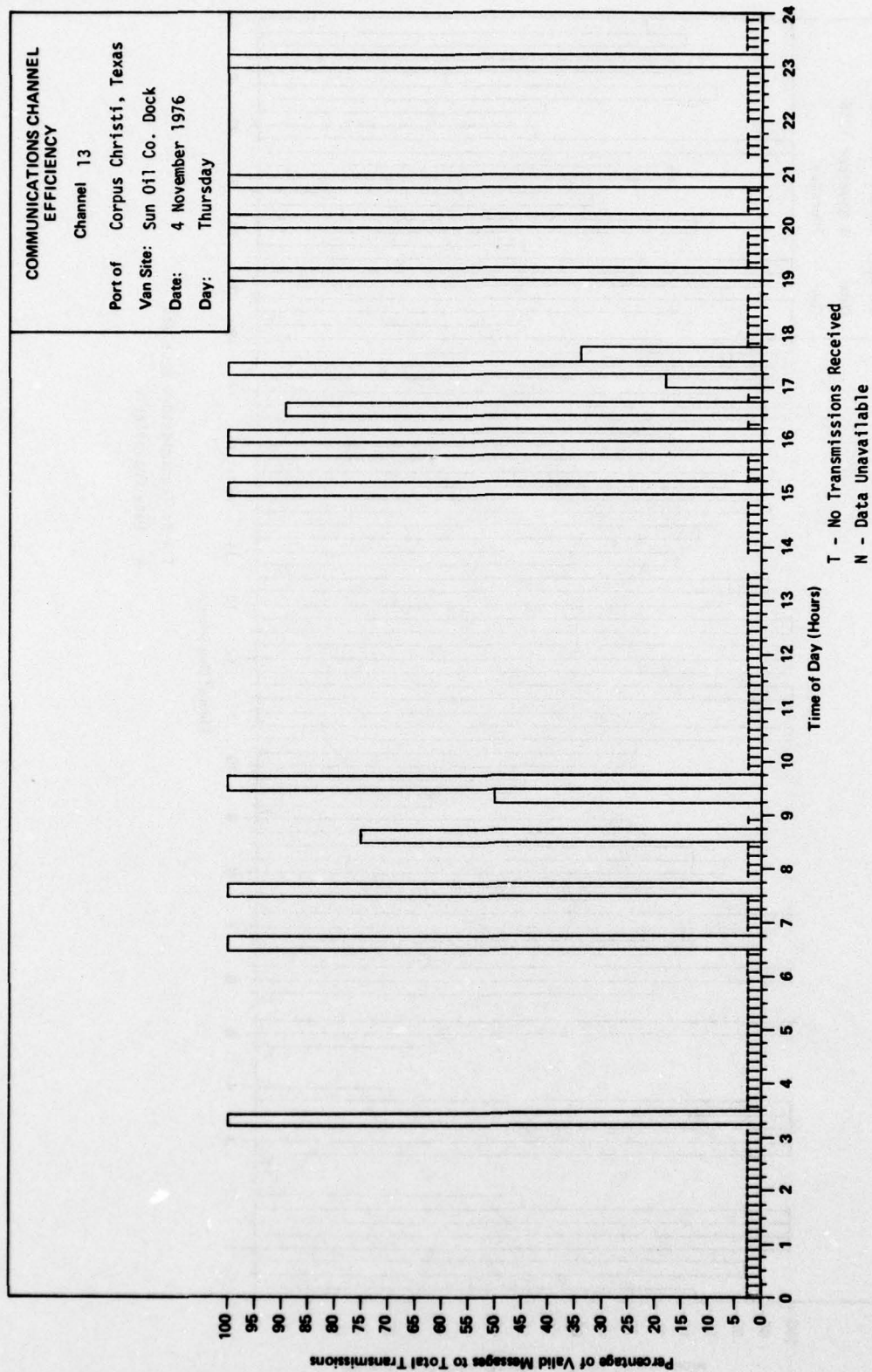


FIGURE 2-42

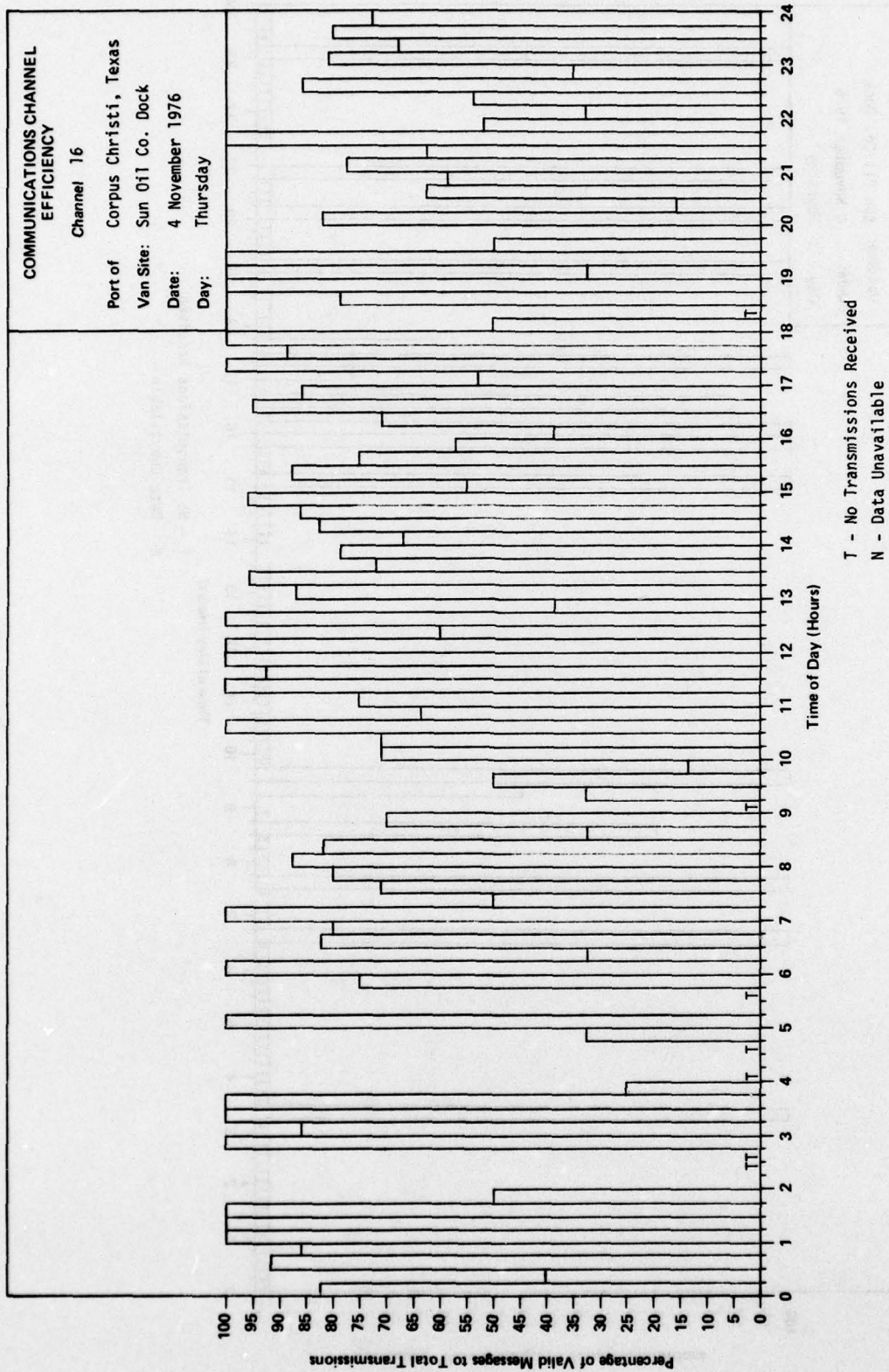


FIGURE 2-43

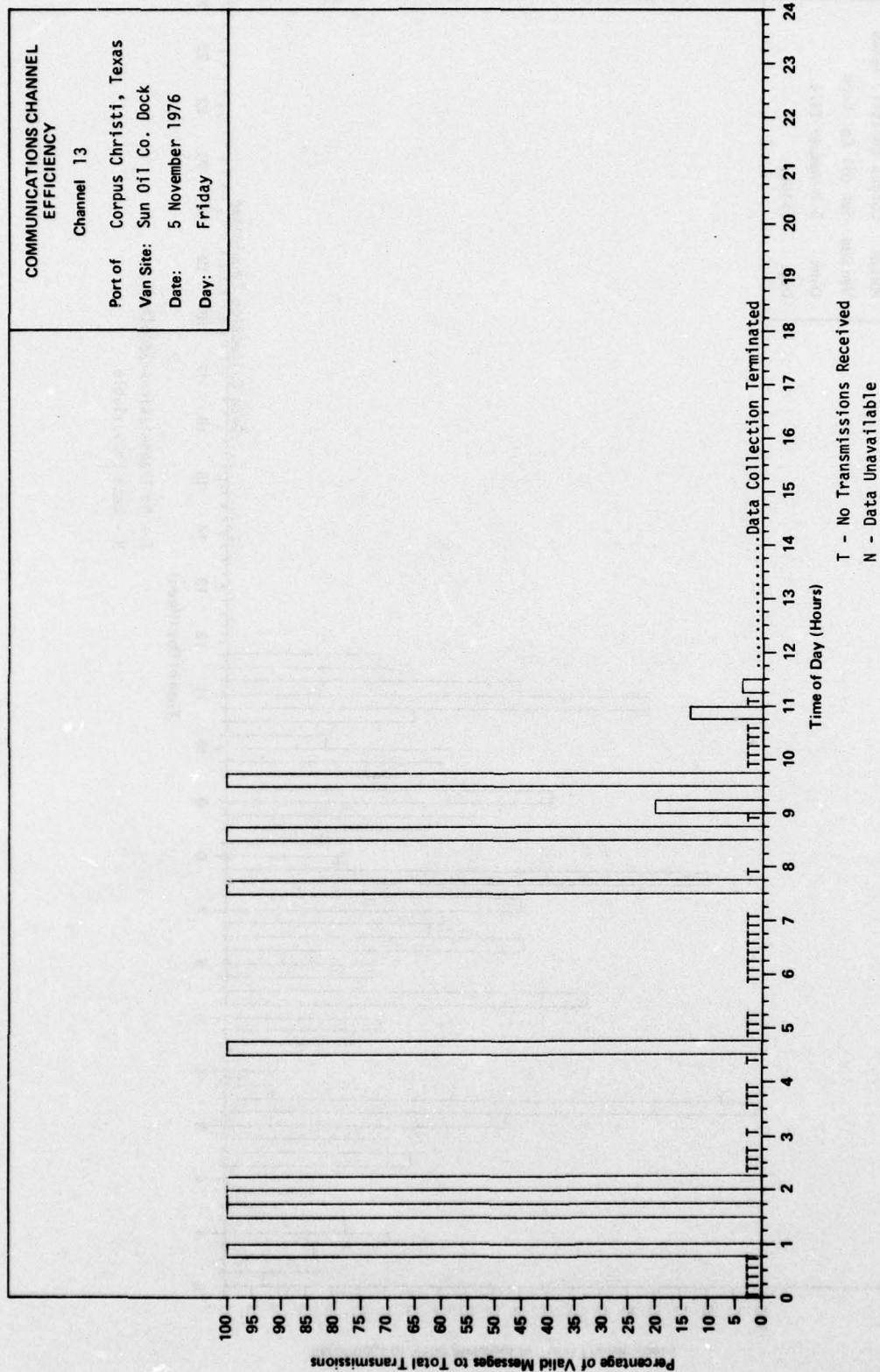


FIGURE 2-44

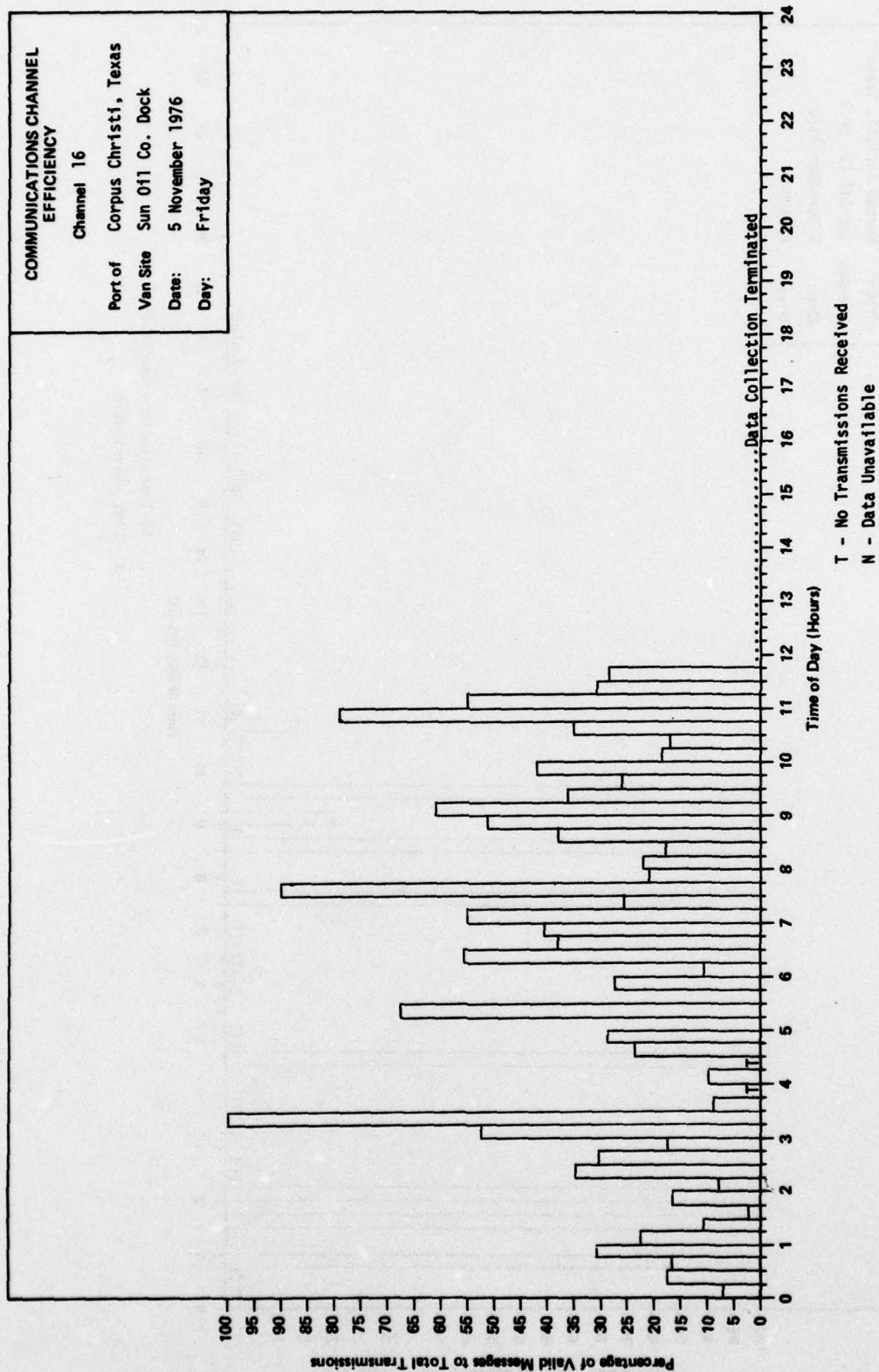


FIGURE 2-45

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
15	2	0.19	1.23
30	0	0.00	0.00
45	0	0.00	0.00
100	0	0.00	0.00
115	0	0.00	0.00
130	0	0.00	0.00
145	1	0.17	1.11
200	3	0.61	4.04
215	0	0.00	0.00
230	0	0.00	0.00
245	1	0.19	1.27
300	8	1.90	12.67
315	1	0.23	1.54
330	4	0.87	5.80
345	9	1.78	11.86
400	0	0.00	0.00
415	0	0.00	0.00
430	0	0.00	0.00
445	0	0.00	0.00
500	0	0.00	0.00
515	0	0.00	0.00
530	0	0.00	0.00
545	0	0.00	0.00
600	0	0.00	0.00
615	10	2.46	16.38
630	3	0.68	4.54
645	0	0.00	0.00
700	0	0.00	0.00
715	0	0.00	0.00
730	6	1.31	8.76
745	0	0.00	0.00
800	0	0.00	0.00
815	2	0.52	3.48
830	7	1.37	9.14
845	2	0.35	2.31
900	5	0.88	5.86
915	0	0.00	0.00
930	9	2.04	13.61
945	9	1.99	13.27
1000	0	0.00	0.00
1015	0	0.00	0.00
1030	0	0.00	0.00
1045	0	0.00	0.00
1100	0	0.00	0.00
1115	0	0.00	0.00
1130	0	0.00	0.00
1145	0	0.00	0.00
1200	0	0.00	0.00

FIGURE 2-46

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
1215	6	1.36	9.07
1230	0	0.00	0.00
1245	0	0.00	0.00
1300	0	0.00	0.00
1315	0	0.00	0.00
1330	11	2.07	13.80
1345	0	0.00	0.00
1400	0	0.00	0.00
1415	0	0.00	0.00
1430	0	0.00	0.00
1445	0	0.00	0.00
1500	0	0.00	0.00
1515	0	0.00	0.00
1530	0	0.00	0.00
1545	0	0.00	0.00
1600	0	0.00	0.00
1615	14	2.66	17.76
1630	0	0.00	0.00
1645	0	0.00	0.00
1700	0	0.00	0.00
1715	0	0.00	0.00
1730	2	0.38	2.50
1745	14	2.58	17.20
1800	17	3.67	24.50
1815	0	0.00	0.00
1830	12	2.71	18.04
1845	8	1.95	13.02
1900	0	0.00	0.00
1915	0	0.00	0.00
1930	0	0.00	0.00
1945	1	0.20	1.36
2000	0	0.00	0.00
2015	0	0.00	0.00
2030	0	0.00	0.00
2045	1	0.25	1.69
2100	1	0.26	1.70
2115	0	0.00	0.00
2130	0	0.00	0.00
2145	0	0.00	0.00
2200	0	0.00	0.00
2215	0	0.00	0.00
2230	0	0.00	0.00
2245	6	1.31	8.74
2300	1	0.18	1.20
2315	0	0.00	0.00
2330	14	2.63	17.54
2345	11	1.85	12.33

FIGURE 2-46 (continued)

TOTAL NUMBER OF TRANSMISSIONS: 201
 AVE. NUM. OF TRANSMISSIONS PER HOUR: 8.4
 TOTAL TRANSMISSION TIME: 0.693 HOURS
 AVERAGE LENGTH OF TRANSMISSION: 12.42 SEC.
 PERCENT CHANNEL UTILIZATION: 2.89%

MESSAGE LENGTH HISTOGRAM

LENGTH OF XMSNS	NUMBER OF XMSNS	PERCENT
0.1 - 0.5 SEC.	0	0.00
0.5 - 1.0 SEC.	1	0.50
1.0 - 1.5 SEC.	0	0.00
1.5 - 2.0 SEC.	0	0.00
2.0 - 2.5 SEC.	0	0.00
2.5 - 3.0 SEC.	0	0.00
3.0 - 3.5 SEC.	0	0.00
3.5 - 4.0 SEC.	0	0.00
4.0 - 4.5 SEC.	0	0.00
4.5 - 5.0 SEC.	0	0.00
5.0 - 5.5 SEC.	0	0.00
5.5 - 6.0 SEC.	0	0.00
6.0 - 6.5 SEC.	0	0.00
6.5 - 7.0 SEC.	0	0.00
7.0 - 7.5 SEC.	0	0.00
7.5 - 8.0 SEC.	0	0.00
8.0 - 8.5 SEC.	0	0.00
8.5 - 9.0 SEC.	0	0.00
9.0 - 9.5 SEC.	0	0.00
9.5 - 10.0 SEC.	5	2.49
LONGER THAN 10 SEC. :	195	97.01

THERE WERE 0 XMSNS OF 00.1 AND 00.0 DURATION

FIGURE 2-46 (continued)

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
15	11	0.47	3.16
30	7	0.18	1.20
45	21	0.98	6.51
100	16	0.25	1.66
115	6	0.09	0.58
130	10	0.20	1.31
145	25	1.00	6.66
200	133	5.01	33.43
215	13	0.31	2.04
230	29	0.68	4.53
245	33	1.36	9.10
300	46	0.79	5.29
315	59	2.12	14.17
330	41	0.56	3.77
345	53	0.94	6.27
400	13	0.04	0.29
415	21	0.22	1.49
430	0	0.00	0.00
445	2	0.24	1.58
500	0	0.00	0.00
515	4	0.19	1.29
530	14	0.20	1.34
545	11	0.49	3.24
600	22	0.91	6.09
615	30	0.96	6.39
630	19	0.50	3.32
645	34	1.45	9.66
700	38	1.78	11.90
715	21	0.50	3.31
730	21	0.85	5.70
745	44	1.55	10.33
800	31	1.05	7.00
815	25	1.24	8.24
830	27	0.94	6.26
845	87	1.20	8.02
900	20	0.63	4.19
915	28	0.52	3.48
930	39	0.54	3.63
945	48	2.60	17.33
1000	57	2.17	14.47
1015	13	0.41	2.71
1030	31	1.72	11.47
1045	20	1.37	9.11
1100	30	1.81	12.04
1115	18	0.93	6.21
1130	15	0.50	3.33
1145	22	0.81	5.38
1200	42	1.29	8.63

FIGURE 2-47

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
1215	109	1.41	9.41
1230	27	0.50	3.36
1245	19	0.26	1.71
1300	22	0.22	1.49
1315	25	0.10	0.64
1330	17	0.14	0.97
1345	74	3.24	21.59
1400	25	0.16	1.09
1415	27	0.34	2.28
1430	5	0.02	0.11
1445	44	1.66	11.08
1500	47	0.50	3.32
1515	19	0.18	1.19
1530	25	0.75	5.02
1545	48	2.63	17.57
1600	48	2.75	18.31
1615	55	1.59	10.62
1630	60	1.46	9.74
1645	23	0.40	2.68
1700	8	0.19	1.27
1715	67	0.87	5.78
1730	11	0.23	1.53
1745	19	0.23	1.53
1800	20	1.31	8.76
1815	18	0.38	2.54
1830	0	0.00	0.00
1845	5	0.29	1.93
1900	15	0.40	2.69
1915	7	0.54	3.61
1930	11	0.32	2.13
1945	4	0.12	0.81
2000	1	0.02	0.12
2015	13	0.36	2.42
2030	10	0.46	3.06
2045	15	0.25	1.66
2100	9	0.17	1.17
2115	5	0.26	1.71
2130	8	0.06	0.43
2145	0	0.00	0.00
2200	3	0.32	2.17
2215	1	0.02	0.13
2230	4	0.31	2.07
2245	19	0.75	4.98
2300	32	0.97	6.50
2315	12	0.20	1.37
2330	4	0.06	0.42
2345	14	0.21	1.41
2400	5	0.27	1.81

FIGURE 2-47 (continued)

TOTAL NUMBER OF TRANSMISSIONS: 2409
 AVE. NUM. OF TRANSMISSIONS PER HOUR: 100.4
 TOTAL TRANSMISSION TIME: 1.208 HOURS
 AVERAGE LENGTH OF TRANSMISSION: 1.81 SEC.
 PERCENT CHANNEL UTILIZATION: 5.03%

MESSAGE LENGTH HISTOGRAM

LENGTH OF XMSNS	NUMBER OF XMSNS	PERCENT
0.1 - 0.5 SEC.	1174	48.73
0.5 - 1.0 SEC.	251	10.42
1.0 - 1.5 SEC.	189	7.85
1.5 - 2.0 SEC.	125	5.19
2.0 - 2.5 SEC.	99	4.11
2.5 - 3.0 SEC.	93	3.86
3.0 - 3.5 SEC.	79	3.28
3.5 - 4.0 SEC.	61	2.53
4.0 - 4.5 SEC.	52	2.16
4.5 - 5.0 SEC.	58	2.41
5.0 - 5.5 SEC.	50	2.08
5.5 - 6.0 SEC.	27	1.12
6.0 - 6.5 SEC.	31	1.29
6.5 - 7.0 SEC.	19	0.79
7.0 - 7.5 SEC.	15	0.62
7.5 - 8.0 SEC.	13	0.54
8.0 - 8.5 SEC.	11	0.46
8.5 - 9.0 SEC.	6	0.25
9.0 - 9.5 SEC.	5	0.21
9.5 - 10.0 SEC.	6	0.25
LONGER THAN 10 SEC. :	45	1.87

THERE WERE 619 XMSNS OF 00.1 AND 00.0 DURATION

FIGURE 2-47 (continued)

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
15	1	0.23	1.52
30	0	0.00	0.00
45	10	1.91	12.76
100	0	0.00	0.00
115	0	0.00	0.00
130	0	0.00	0.00
145	8	1.59	10.62
200	0	0.00	0.00
215	0	0.00	0.00
230	0	0.00	0.00
245	0	0.00	0.00
300	0	0.00	0.00
315	0	0.00	0.00
330	1	0.17	1.11
345	0	0.00	0.00
400	1	0.23	1.56
415	3	0.58	3.83
430	8	1.75	11.64
445	1	0.22	1.46
500	1	0.24	1.63
515	0	0.00	0.00
530	0	0.00	0.00
545	3	0.61	4.08
600	0	0.00	0.00
615	0	0.00	0.00
630	0	0.00	0.00
645	0	0.00	0.00
700	0	0.00	0.00
715	0	0.00	0.00
730	0	0.00	0.00
745	0	0.00	0.00
800	0	0.00	0.00
815	0	0.00	0.00
830	6	1.09	7.26
845	0	0.00	0.00
900	0	0.00	0.00
915	0	0.00	0.00
930	3	0.74	4.97
945	0	0.00	0.00
1000	0	0.00	0.00
1015	0	0.00	0.00
1030	15	3.11	20.74
1045	0	0.00	0.00
1100	0	0.00	0.00
1115	17	3.31	22.10
1130	0	0.00	0.00
1145	12	2.59	17.24
1200	6	1.56	10.43

FIGURE 2-48

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
1215	30	6.08	40.51
1230	6	1.23	8.21
1245	0	0.00	0.00
1300	0	0.00	0.00
1315	0	0.00	0.00
1330	2	0.38	2.50
1345	9	1.96	13.07
1400	1	0.18	1.22
1415	2	0.35	2.32
1430	4	0.76	5.09
1445	30	5.91	39.41
1500	16	3.29	21.94
1515	0	0.00	0.00
1530	0	0.00	0.00
1545	5	1.21	8.08
1600	4	0.88	5.87
1615	7	1.45	9.67
1630	2	0.49	3.29
1645	4	0.96	6.38
1700	0	0.00	0.00
1715	16	3.47	23.17
1730	6	1.10	7.32
1745	9	2.08	13.86
1800	0	0.00	0.00
1815	5	1.14	7.59
1830	1	0.22	1.47
1845	0	0.00	0.00
1900	1	0.27	1.78
1915	0	0.00	0.00
1930	5	0.91	6.07
1945	0	0.00	0.00
2000	2	0.46	3.07
2015	4	0.86	5.74
2030	1	0.29	1.91
2045	0	0.00	0.00
2100	9	1.75	11.70
2115	0	0.00	0.00
2130	0	0.00	0.00
2145	0	0.00	0.00
2200	19	3.82	25.44
2215	5	1.20	8.00
2230	0	0.00	0.00
2245	9	1.82	12.13
2300	11	1.99	13.27
2315	4	0.70	4.68
2330	0	0.00	0.00
2345	0	0.00	0.00
2400	2	0.49	3.24

FIGURE 2-48 (continued)

TOTAL NUMBER OF TRANSMISSIONS: 327
AVE. NUM. OF TRANSMISSIONS PER HOUR: 13.6
TOTAL TRANSMISSION TIME: 1.127 HOURS
AVERAGE LENGTH OF TRANSMISSION: 12.41 SEC.
PERCENT CHANNEL UTILIZATION: 4.70%

MESSAGE LENGTH HISTOGRAM

LENGTH OF XMSNS	NUMBER OF XMSNS	PERCENT
0.1 - 0.5 SEC.	0	0.00
0.5 - 1.0 SEC.	0	0.00
1.0 - 1.5 SEC.	0	0.00
1.5 - 2.0 SEC.	0	0.00
2.0 - 2.5 SEC.	0	0.00
2.5 - 3.0 SEC.	0	0.00
3.0 - 3.5 SEC.	0	0.00
3.5 - 4.0 SEC.	0	0.00
4.0 - 4.5 SEC.	0	0.00
4.5 - 5.0 SEC.	0	0.00
5.0 - 5.5 SEC.	0	0.00
5.5 - 6.0 SEC.	0	0.00
6.0 - 6.5 SEC.	0	0.00
6.5 - 7.0 SEC.	0	0.00
7.0 - 7.5 SEC.	0	0.00
7.5 - 8.0 SEC.	0	0.00
8.0 - 8.5 SEC.	0	0.00
8.5 - 9.0 SEC.	0	0.00
9.0 - 9.5 SEC.	0	0.00
9.5 - 10.0 SEC.	16	4.89
LONGER THAN 10 SEC. :	311	95.11

THERE WERE 0 XMSNS OF 00.1 AND 00.0 DURATION

FIGURE 2-48 (continued)

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
15	15	0.45	3.00
30	9	0.31	2.09
45	7	0.33	2.22
100	4	0.02	0.12
115	0	0.00	0.00
130	12	0.18	1.20
145	7	0.18	1.23
200	2	0.01	0.04
215	5	0.03	0.23
230	0	0.00	0.00
245	13	0.20	1.32
300	7	0.09	0.57
315	3	0.09	0.62
330	9	0.22	1.46
345	2	0.01	0.04
400	8	0.49	3.26
415	10	0.16	1.10
430	13	1.28	8.54
445	13	0.83	5.56
500	5	0.05	0.31
515	5	0.15	1.00
530	0	0.00	0.00
545	10	0.14	0.93
600	13	0.82	5.44
615	15	0.71	4.74
630	12	0.45	3.03
645	6	0.49	3.27
700	30	0.34	2.29
715	39	1.55	10.37
730	30	0.74	4.92
745	14	0.64	4.24
800	23	2.05	13.67
815	36	1.35	9.01
830	38	1.15	7.67
845	50	1.30	8.67
900	56	2.27	15.14
915	35	0.88	5.87
930	4	0.26	1.71
945	26	0.88	5.89
1000	22	1.20	7.99
1015	39	1.49	9.94
1030	44	0.74	4.96
1045	42	2.06	13.73
1100	28	1.83	12.22
1115	59	1.69	11.24
1130	15	0.72	4.83
1145	21	0.72	4.81
1200	29	1.01	6.72

FIGURE 2-49

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
1215	89	1.61	10.71
1230	44	1.32	8.82
1245	6	0.38	2.52
1300	1	0.03	0.19
1315	27	0.81	5.39
1330	9	1.01	6.72
1345	63	2.32	15.47
1400	59	1.65	11.01
1415	65	2.22	14.81
1430	30	0.82	5.44
1445	39	1.57	10.49
1500	58	1.36	9.06
1515	77	1.56	10.43
1530	57	1.81	12.08
1545	37	2.40	16.01
1600	39	1.33	8.84
1615	20	0.75	5.01
1630	14	0.71	4.71
1645	10	0.50	3.34
1700	24	0.61	4.07
1715	11	0.71	4.74
1730	65	2.28	15.19
1745	16	0.32	2.17
1800	11	0.33	2.19
1815	47	1.37	9.13
1830	20	0.59	3.91
1845	22	1.59	10.63
1900	18	1.36	9.09
1915	16	1.39	9.30
1930	1	0.01	0.06
1945	0	0.00	0.00
2000	8	0.29	1.93
2015	22	1.52	10.13
2030	2	0.05	0.31
2045	2	0.13	0.87
2100	0	0.00	0.00
2115	1	0.00	0.02
2130	5	0.20	1.31
2145	4	0.22	1.50
2200	1	0.04	0.26
2215	9	0.20	1.36
2230	23	0.29	1.96
2245	14	0.19	1.29
2300	20	0.78	5.20
2315	20	0.40	2.69
2330	13	0.28	1.86
2345	25	0.81	5.39
2400	15	0.43	2.86

FIGURE 2-49 (continued)

TOTAL NUMBER OF TRANSMISSIONS: 2064
AVE. NUM. OF TRANSMISSIONS PER HOUR: 86.0
TOTAL TRANSMISSION TIME: 1.219 HOURS
AVERAGE LENGTH OF TRANSMISSION: 2.13 SEC.
PERCENT CHANNEL UTILIZATION: 5.08%

MESSAGE LENGTH HISTOGRAM

LENGTH OF XMSNS	NUMBER OF XMSNS	PERCENT
0.1 - 0.5 SEC.	797	38.61
0.5 - 1.0 SEC.	254	12.31
1.0 - 1.5 SEC.	152	7.36
1.5 - 2.0 SEC.	143	6.93
2.0 - 2.5 SEC.	105	5.09
2.5 - 3.0 SEC.	92	4.46
3.0 - 3.5 SEC.	89	4.31
3.5 - 4.0 SEC.	74	3.59
4.0 - 4.5 SEC.	70	3.39
4.5 - 5.0 SEC.	65	3.15
5.0 - 5.5 SEC.	45	2.18
5.5 - 6.0 SEC.	26	1.26
6.0 - 6.5 SEC.	22	1.07
6.5 - 7.0 SEC.	17	0.82
7.0 - 7.5 SEC.	20	0.97
7.5 - 8.0 SEC.	18	0.87
8.0 - 8.5 SEC.	12	0.58
8.5 - 9.0 SEC.	9	0.44
9.0 - 9.5 SEC.	7	0.34
9.5 - 10.0 SEC.	4	0.19
LONGER THAN 10 SEC. :	43	2.08

THERE WERE 495 XMSNS OF 00.1 AND 00.0 DURATION

FIGURE 2-49 (continued)

APPENDIX A

GEOGRAPHICAL DESCRIPTION

The following description of the Corpus Christi area (Figure A-1) was excerpted from the United States Coast Pilot, Volume 5, ninth edition (1976), and is included here to make this report more complete and readily understandable.

A.1 CORPUS CHRISTI

Corpus Christi, on the west side of Corpus Christi Bay and 18 miles from Aransas Pass, is the most important city commercially on the Texas coast southwest of Galveston. The principal industries are in seafood processing, meat packing and freezing, agriculture, livestock, petroleum products, petrochemical and industrial chemicals, natural gas, manufacture of plastics, steel products, aluminum, zinc, machinery, oil field equipment, paper products, agricultural fertilizers, cement, gypsum products, textiles, and the shipment of wheat, cotton, and general cargo.

A.2 CORPUS CHRISTI BAY AND APPROACHES

Corpus Christi is a large body of water, roughly elliptical in shape, lying to the west of Mustang Island and connected with Aransas Pass by the Corpus Christi Channel. The bay is about 15 miles long in an east and west direction and 11 miles at its widest part. About the east end of the bay the depths are 8 to 11 feet, and most of the rest of the bay has depths of 12 to 13 feet.

Aransas Pass is the principal approach from the Gulf of Mexico to Aransas and Corpus Christi Bays and their tributaries. The pass lies between San Jose Island on the north and Mustang Island to the south. Harbor Island, directly opposite the inner end of the pass, separates Aransas Bay from Corpus Christi Bay.

Two jetties extend into the Gulf from San Jose and Mustang Islands. There are several submerged spurs in the bend of the north jetty, and three submerged spurs extend from the south jetty. A submerged wreck, covered 24 feet, lies to the south of the channel inside the jetties.

The approach to Aransas Pass is marked by a lighted whistle buoy, 5.5 miles offshore, and a lighted buoy 1.5 miles off the north jetty. The entrance channel is marked by a lighted buoy at the submerged outer end of each jetty, a 301-degree lighted range, lighted buoys, and lights.

Vessels should approach Aransas Pass through the prescribed Safety Fairways. The Aransas Pass Safety Fairway, the southeast approach to Aransas Pass, consists of partially divided parallel shipping fairways instead of a single fairway. These parallel fairways are not a traffic separation scheme. However, in the interest of vessel traffic safety, the use of the northeast lane for inbound traffic and the southwest lane for outbound traffic is recommended.

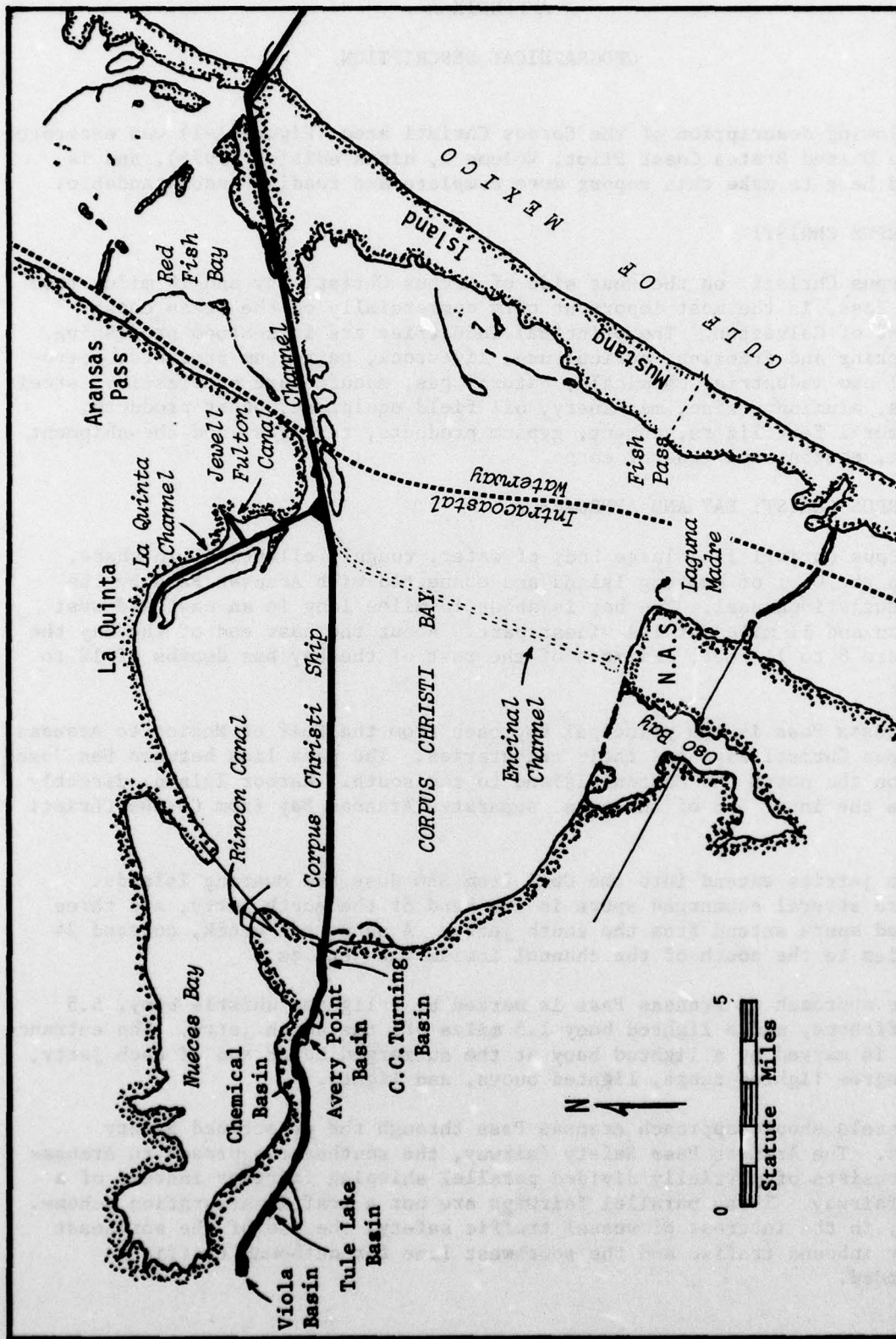


FIGURE A-1: CORPUS CHRISTI SHIP CHANNEL

A.3 CHANNELS

The entrance channel through Aransas Pass is protected by jetties. A Federal project provides for an outer bar channel 42 feet deep, a jetty channel 42 feet deep decreasing to 40 feet in the inner part, and an inner basin at Harbor Island with a depth of 40 feet.

Corpus Christi Channel extends from Aransas Pass to Corpus Christi on the west side of Corpus Christi Bay. For about four miles, at the east end, it extends through Turtle Cove between Harbor Island on the north and Mustang Island on the south; thence across Corpus Christi Bay to Corpus Christi. The channel is straight except for a 15-degree bend at about its midway point just south of Ingleside Cove. The Federal project depth is 45 feet to the Viola Turning Basin, 28.5 miles from the outer bar.

La Quinta Channel branches north from Corpus Christi Channel, and follows the northeast side of Corpus Christi Bay to a turning basin at the town of La Quinta. Federal project depth is 45 feet in the channel and basin.

Jewel Fulton Canal branches off La Quinta Channel about two miles northwest of its junction with Corpus Christi Channel. The canal extends about 0.8 mile northeast to a turning basin in Kinney Bayou. The controlling depth was 11 feet in 1974. The entrance channel is marked by a light and daybeacons.

Encinal Channel branches off from Corpus Christi Channel about 0.6 mile west of the La Quinta Channel junction. It extends about seven miles south to a turning basin at the Naval Air Station on Encinal Peninsula on the south side of Corpus Christi Bay. The controlling depths were reported to be about 10 feet in the channel and 12 feet in the basin in 1972. The channel is seldom used.

A.4 ANCHORAGES

Vessels should anchor off Aransas Pass in the Aransas Pass Fairway Anchorages.

Inside Aransas Pass, there is no suitable anchorage for deep-draft vessels. Light-draft vessels up to about a 10-foot draft can anchor in Lydia Ann Channel north of Inner Basin. Also, lighter draft vessels can anchor in Corpus Christi Bay in depths up to 13 feet and behind the breakwater off Corpus Christi in depths up to 15 feet. Under certain conditions, ships are anchored to short scope in the turning basin.

A.5 TIDES AND CURRENTS

The diurnal range of tide at Aransas Pass is 1.7 feet. In Corpus Christi and Redfish Bays the periodic tide is too small to be of any practical importance.

The currents at times have velocities exceeding 2.5 knots in Aransas Pass; they are greatly influenced by winds.

Winds from any east direction make a rough bar and raise the water inside as much as 2 feet above normal. Winds from any west direction have an opposite tendency. A sudden shift of the wind from south to north makes an especially rough bar for a short time. During summer months, south winds prevail, becoming moderate to fresh in the afternoon.

A.6 WEATHER

Although located on the Gulf, Corpus Christi has an intermediate climate between that of the humid subtropical region to the northeast and those of the semi-arid region of the west and southwest.

Normal rainfall for Corpus Christi is about 28 inches a year. Peak rainfall months are May and September, and the winter months have the least amounts. The season of tropical storms is from June to November and affects the rainfall during this period, otherwise these months are usually dry. Several months during the years of record have had no rainfall or only a trace. Since records began in 1887, snow has fallen on an average of about one day every two years.

There is little change in the day-to-day weather in the summer, except for an occasional rain shower or a tropical storm in the area. Maximum temperatures range in the high eighties to low nineties, except for brief periods in the high nineties, occasioned by a shift in the wind direction from the prevailing southeast to south and southwest. The sea breeze during the afternoon and evening moderates the heat of the summer day. Minimum temperatures are usually in the low seventies. The maximum temperatures usually occur about noon, with afternoons more pleasant than mornings in that they are usually cloudless and windy. In the summer season, the region receives near 80 percent of possible sunshine.

The fall months of September and October are essentially an extension of the summer months. November is a transition to the conditions of the coming winter months, with greater temperature extremes, stronger winds, and the first occurrences of "northers." The winters are relatively mild. Temperatures below 32°F (0°C) seldom occur near the bay. January is the coldest month with a normal monthly temperature of 57.4°F (14.1°C) and a prevailing northerly wind. The most extreme occurrences of cold weather are those in which daytime maxima do not exceed 32°F (0°C), which occur on the average of not more than about once every three to four years.

Relative humidity, because of the nearness of the Gulf of Mexico, is high throughout the year. However, during the afternoons, the humidity usually drops to 50 and 60 percent.

Severe tropical storms average about one every ten years. Lesser strength storms average about one every five years. The city of Corpus Christi has a feature not found in most other coastal cities. A bluff rises 30 to 40 feet above the level of the lowland areas near the bay. This serves as a natural protection from high water. Protection for the main city is now furnished by seawalls. The chief hurricane months are August and September, although

tropical storms have occurred as early as June and as late as October. Most of the storms pass either to the south or east of the city. Tornadoes are of infrequent occurrence in the area. Hail occurs about once a year.

A.7 PILOTAGE

Pilotage is compulsory for all foreign vessels and U.S. vessels under register in foreign trade. Pilotage is optional for coastwise vessels that have on board a pilot licensed by the Federal government. The Aransas-Corpus Christi pilots maintain an office and lookout on the south jetty. The pilot boat is a 50-foot steel vessel with a black hull and white superstructure with the word "PILOT" on each side of the deckhouse. The pilot boat shows the standard pilot lights at night and the International Code flag "P" by day. The pilots board vessels between the sea buoy and Buoy No. 3.

The pilots monitor 2738 KHz and VHF-FM Channels 12 (156.60 MHz) and 16 (156.80 MHz) continuously, and the pilots carry portable VHF-FM radiotelephones and use Channels 12 (156.60 MHz) and 13 (156.65 MHz) as working frequencies.

Pilot services are available 24 hours a day, and arrangements for pilot services are usually made through the ship's agents. A 2-hour advance notice of time of arrival is requested.

The harbormaster, pilot station, pilot boat, and all tugs and pilots maintain radio communications on VHF-FM Channels 12 (156.60 MHz) and 16 (156.80 MHz) for docking, undocking, and all harbor movements.

A.8 COAST GUARD

The Captain of the Port, a Marine Inspection Office, and a vessel documentation office are in Corpus Christi.

APPENDIX B

WHARVES

Corpus Christi has more than 70 piers and wharves. Only the deep-draft facilities are described. The alongside depths for the facilities described are reported. Water and electrical shore power connections are available at most piers and wharves. Almost all the facilities have highway and railroad connections.

General cargo at the port is usually handled by ship's tackle; special handling equipment, if available, is mentioned in the description of the particular facility.

Over 45 acres of open storage space, 2 million square feet of covered storage, and over 900,000 cubic feet of cold storage space are available in the port. Mobile cranes up to 35 tons, a 45-ton floating crane, and a 100-ton stiff-legged derrick are available at the port.

B.1 HARBOR ISLAND

American Petrofina Dock: 260-foot face, 395 feet with dolphins; 40 feet alongside; deck height, 13 feet; shipment of crude oil; bunkering vessels; owned and operated by American Petrofina Corporation.

Humble Pipe Line Company Dock No. 1: 233-foot face, 325 feet with breasting platform; 40 feet alongside; deck height, 14 feet; shipment of crude oil; bunkering vessels; owned and operated by Humble Pipe Line Company.

Humble Pipe Line Company Dock No. 2: 233-foot face, 325 feet with breasting platform; 28 feet alongside; deck height, 14 feet; receipt of crude oil; loading barges for bunkering vessels; owned and operated by Humble Pipe Line Company.

B.2 PORT INGLESIDE

Sun Pipe Line Company Wharf: 144-foot face, 965 feet with dolphins; 42 to 40 feet alongside; deck height, 12 feet; receipt and shipment of crude oil and occasionally petroleum products; owned and operated by Sun Pipe Line Company.

B.3 LA QUINTA

Reynolds Metals Company, Sherwin Plant, Alumina Dock: 400-foot face, 960 feet with dolphins; 40 feet alongside; deck height, 9 feet; fixed loading tower with loading chute, conveyor system, loading rate 750 tons per hour, 35-ton mobile crane with 1.5 cubic yard bucket; shipment of bulk and bagged alumina, aluminum pigs and billets, and scrap carbon; receipt and shipment of fuel oil; bunkering vessels; owned and operated by Reynolds Metals Company.

Reynolds Metals Company, Sherwin Plant, Pier: 60-foot face, east and west sides 705 feet long; 40 feet alongside; deck height, 10 feet; electric traveling unloading tower with 2.5-ton bucket on west side, conveyor, unloading rate about 360 tons per hour, hopper and conveyor system for self-unloading vessels; receipt of bauxite and caustic soda and fuel oil, shipment of fuel oil; bunkering vessels; owned and operated by Reynolds Metals Company.

B.4 NORTH SIDE CORPUS CHRISTI TURNING BASIN

Port of Corpus Christi, Cargo Dock No. 9: 660-foot face, 775 feet with dolphins; 34 feet alongside; deck height, 15 feet; 32,000 square feet covered storage, cranes up to 30 tons, electric magnets and buckets; receipt and shipment of general cargo, receipt of molasses; owned and operated by Nueces County Navigation District No. 1.

Port of Corpus Christi, Cargo Dock No. 10: 362-foot face; 34 feet alongside; deck height, 15 feet; 28,000 square feet covered storage; cranes up to 30 tons, electric magnets and buckets; receipt and shipment of general cargo; owned and operated by Nueces County Navigation District No. 1.

Port of Corpus Christi, Cargo Dock No. 11: 300-foot face, 350 feet with dolphins; 34 feet alongside; deck height, 15 feet; cranes up to 30 tons, electric magnets and buckets; receipt and shipment of lead and zinc ores, aluminum pigs, zinc, scrap metal, iron and steel products, and newsprint; owned and operated by Nueces County Navigation District No. 1.

Port of Corpus Christi, Oil Dock No. 2: 151-foot face, 200 feet with dolphins; 32 feet alongside; deck height, 12 feet; receipt and shipment of crude oil, petroleum products, and liquid fertilizers; owned and operated by Nueces County Navigation District No. 1.

B.5 SOUTH SIDE OF CORPUS CHRISTI TURNING BASIN

Port of Corpus Christi, Wharves Nos. 1 and 2: 641-foot face; 32 feet alongside; deck height, 15 feet; 64,000 square feet covered storage; receipt and shipment of general cargo; owned and operated by Nueces County Navigation District No. 1.

Port of Corpus Christi, Wharves Nos. 3, 4, 5, and 6: 1,246-foot face; 30 feet alongside; deck height, 15 feet; 131,000 square feet covered storage; receipt and shipment of general cargo; owned and operated by Nueces County Navigation District No. 1.

Port of Corpus Christi, Wharf No. 8: 440-foot face; 32 feet alongside; deck height, 15 feet; 44,000 square feet covered storage, 15 acres of open storage; receipt and shipment of general cargo; owned and operated by Nueces County Navigation District No. 1.

Port of Corpus Christi, Wharves Nos. 14 and 15: 938-foot face, 1,038 feet with dolphins; 34 to 30 feet alongside; deck height, 15 feet; 72,000 square feet covered storage, 1.3 acres of open storage, 100-ton stiff-legged derrick; receipt and shipment of general cargo; owned and operated by Nueces County Navigation District No. 1.

Port of Corpus Christi, Oil Dock No. 5: 72-foot face, 250 feet with dolphins; 32 feet alongside; deck height, 14 feet; receipt of petroleum products; bunkering vessels; owned and operated by Nueces County Navigation District No. 1.

Mobil Oil Corporation Wharf: 70-foot face, 200 feet with dolphins; 36 feet alongside; deck height, 12 feet; receipt and shipment of petroleum products, shipment of crude oil; owned and operated by Mobil Oil Corporation.

Southwestern Oil and Refining Company Wharf No. 3: 110-foot face, 225 feet with dolphins; 40 feet alongside; deck height, 15 feet; receipt of crude oil, receipt and shipment of petroleum products, petrochemicals, and chemicals; bunkering vessels; owned and operated by Southwestern Oil and Refining Company.

B.6 NORTH SIDE INDUSTRIAL CANAL

Corpus Christi Public Grain Elevator Wharf: 205-foot face, 360 feet with dolphins; 35 feet alongside; deck height, 14 feet; grain gallery with conveyors and five loading spouts, loading rate 80,000 bushels per hour, 5.5-million-bushel grain elevator; shipment of grain; owned and operated by Nueces County Navigation District No. 1.

B.7 SOUTH SIDE INDUSTRIAL CANAL

Southwestern Oil and Refining Company Wharf No. 2: 109-foot face, 300 feet with dolphins; 40 feet alongside; deck height, 10 feet; receipt of crude oil, receipt and shipment of petroleum products and petrochemicals; bunkering vessels; owned and operated by Southwestern Oil and Refining Company.

Champlain Refining Corporation, Ship Dock: 111-foot face, 324 feet with dolphins; 40 feet alongside; deck height, 14 feet; receipt of crude oil, receipt and shipment of petroleum products; bunkering vessels; owned and operated by Champlain Refining Corporation.

B.8 SOUTH SIDE AVERY POINT TURNING BASIN

PPG Industrial Pier: 100-foot face, 520 feet with dolphins, east and west sides 520 feet long, 440 feet of berthing space; 30 feet alongside; deck height, 15 feet; 21,000 square feet covered storage; conveyor system, loading rate 200 tons per hour, receipt and shipment of liquid caustic soda, shipment of bulk and packaged chemicals; owned and operated by PPG Industries, Incorporated.

B.9 SOUTH SIDE TULE LAKE CHANNEL

Port of Corpus Christi, Oil Dock No. 4: 143-foot face, 225 feet with dolphins; 40 feet alongside; deck height, 16 feet; receipt and shipment of crude oil and petroleum products, shipment of petrochemicals; bunkering vessels, loading barges for bunkering vessels; owned and operated by Nueces County Navigation District No. 1.

Port of Corpus Christi, Oil Dock No. 7: 143-foot face, 230 feet with dolphins; 40 feet alongside; deck height, 16 feet; receipt and shipment of crude oil and petroleum products, shipment of petrochemicals; bunkering vessels, loading barges for bunkering vessels; owned and operated by Nueces County Navigation District No. 1.

Port of Corpus Christi, Oil Dock No. 11: 143-foot face, 290 feet with dolphins; 40 feet alongside; deck height, 16 feet; receipt and shipment of crude oil and petroleum products, shipment of petrochemicals; bunkering vessels; owned and operated by Nueces County Navigation District No. 1. NOTE: An emergency yellow strobelight has been established on Oil Dock No. 11 to warn approaching traffic in the event of a liquified flammable gas spill, fire, or other hazardous condition.

Producers Grain Corporation, Elevator Wharf: 340-foot face, 460 feet with platforms; 40 feet alongside; deck height, 10 feet; grain gallery with conveyor and five loading spouts, loading rate 40,000 bushels per hour, 6.25-million-bushel grain elevator and warehouse; shipment of grain; owned and operated by Producers Grain Corporation.

B.10 NORTH SIDE TULE LAKE CHANNEL

Port of Corpus Christi, Bulk Materials Dock: 396-foot face; 38 feet alongside; deck height, 12 feet; traveling unloading tower with 7-cubic yard buckets, unloading rate 1,000 tons per hour; receipt of bulk ores and other dry bulk commodities; owned and operated by Nueces County Navigation District No. 1.

B.11 SOUTH SIDE VIOLA TURNING BASIN

Port of Corpus Christi, Oil Dock No. 8: 87-foot face, 230 feet with dolphins; 41 feet alongside; deck height, 14 feet; receipt and shipment of petroleum products, shipment of petrochemicals; bunkering vessels, loading barges for bunkering vessels; owned and operated by Nueces County Navigation District No. 1.

Port of Corpus Christi, Oil Dock No. 9: 57-foot face, 350 feet with dolphins; 32 feet alongside; deck height, 12 feet; receipt of crude oil, receipt and shipment of petroleum products, shipment of petrochemicals; bunkering vessels; owned and operated by Nueces County Navigation District No. 1.